FORM 75039
1/99

BETTIS ATOMIC POWER LABORATORY

SAFETY AND HEALTH RULES
FOR ON-SITE SERVICES

A. INTRODUCTION

A primary goal of the Bettis Atomic Power Laboratory is to provide a safe workplace for all employees, subcontractor personnel, and visitors so that work may be accomplished effectively while reducing occupational injuries, illnesses, and related property loss to the lowest possible level. This manual furnishes requirements, guidelines, and background information to aid in achieving this goal.

The requirements of 29 CFR 1926, Construction Safety and Health Standards, are applicable to the Seller and its lower-tier subcontractors for on-site construction, and the requirements of 29 CFR 1910, General Safety and Health Standards, are applicable to the Seller and its lower-tier subcontractors for other on-site services performed at the Bettis Atomic Power Laboratory.

In addition to the above referenced standards the safety and health rules herein are applicable to the Seller and its lower-tier subcontractors performing work at the Bettis Atomic Power Laboratory. These rules include requirements from 29CFR 1926 and 29CFR 1910 and rules unique to the Bettis Site. The Seller has prime responsibility for ensuring all lower-tier subcontractors are aware of Bettis and OSHA safety requirements, including safety training and physical examinations. Questions should be directed to the cognizant Bettis representative for the work. On-the-job monitoring for compliance may be conducted by Bettis and Department of Energy (DOE) personnel.

B. EMERGENCIES

1. In case of an emergency such as a motor vehicle accident, property damage, or personal injury, promptly notify the cognizant Bettis representative for the job. Ensure proper medical attention is provided to any injured person first.

2. In case of fire, (1) activate the nearest fire alarm box, (2) if the user knows how to use a fire extinguisher properly, attempt to extinguish the flames with a suitable fire extinguisher provided doing so does not place the user in danger, and (3) notify the cognizant Bettis representative.

3. In case of a spill of hazardous material or an accumulation of hazardous vapors, evacuate the immediate area, notify the cognizant Bettis representative, and keep personnel away until assistance arrives.

4. Ensure the integrity of any accident scene is maintained until a complete investigation has been conducted and the area is released by authorized Bettis management.

C. EMERGENCY EQUIPMENT

1. Fire protection systems must be deactivated before any work on or near the systems is performed which could cause them to falsely activate or alarm. Examples of such work include internal work on the system itself or work which could result in bumping or vibration of the system. Deactivation and reactivation must be done by designated Bettis personnel upon notification by the cognizant Bettis representative. Fire protection systems and equipment (such as sprinklers and fire extinguishers) shall not be relocated until the cognizant Bettis representative has obtained concurrence from Protection Systems.

2. Safety equipment (such as eye wash fountains, safety showers, spill kits, respirators, or first aid cabinets) shall not be relocated or taken out of service without permission of the cognizant Bettis representative. Access to this equipment shall be maintained at all times.

NOTE

Permission to relocate emergency equipment consistent with specification requirements is specifically given by signature in the appropriate block of any drawing requiring the relocation.

D. SIGNS AND BARRICADES

1. Safety signs and barricades shall be observed by all personnel. The purpose of the barricades and signs is to protect personnel from potential safety hazards.

2. Appropriate signs or barricades shall be provided by Bettis and posted by the Seller depending upon the type of operation involved. The following operations require signs or barricades:

   a. Welding operations require a welding screen.

   b. Grinding, welding, and other operations that create a potential eye hazard require signs stating "CAUTION - Eye Protection Required."

   c. Areas where men are working above and there is a potential for falling objects require signs stating "CAUTION - Men Working Above," "Hard Hat Required," and barricades as appropriate.

   d. Open holes in the ground or floors, such as excavations, trenches, and manholes that present a hazard to pedestrians or vehicular traffic shall be barricaded and posted to prevent entry except by authorized personnel.

   e. Areas used for storing or dispensing flammable liquids or any other areas where a fire hazard exists shall be posted "DANGER - No Smoking or Open Flames."

3. The basic colors for designating the makeup of standard safety signs and tags are as follows:

   Red for Danger;
   Yellow for Caution; and
   Green for Safety First.

4. All signs and tags shall provide for the warning of, or safety instructions to, employees and visitors who may be exposed to hazards.

   a. DANGER shall be used where an **immediate hazard** exists. DANGER signs indicate that special precautions are necessary.
   b. CAUTION shall be used to warn against potential hazards or to caution against **unsafe practices**. CAUTION signs indicate what precautions are required.

c. SAFETY INSTRUCTION shall be used where there is a need for **general instructions** relative to safety measures. The signs are often identified by the words, "SAFETY FIRST."

All signs for an area shall be consistent. The inserts shall be the same for each sign. Only one level of hazard (DANGER, CAUTION, or SAFETY FIRST) shall be assigned to an area.

The wording of any sign or tag should:

- be easily read and to the point;
- contain sufficient, easy-to-understand information;
- make a positive suggestion; and
- be accurate in fact.

5. Safety barricades shall be erected to isolate areas where potential safety hazards exist. Safety barricades may be constructed of yellow and black rope or tape or commercial-type stands, and should be posted with a safety sign. The meaning of safety barricades is clear - STAY OUT unless you are authorized to be in the area and are properly attired.

a. When no specific safety information is posted on or at a barricade, personnel shall assume all safety barricades carry the following warning: **Authorized Personnel Only. Do Not Enter Without Knowledge of the Hazards and Without Necessary Protective Equipment.**

b. Construction and maintenance activities often restrict normal access along sidewalks, hallways, and paths, requiring pedestrians to select an alternate route. Personnel erecting safety barricades must choose between (1) closing the restricted sidewalk, hallway, or path and diverting pedestrians to other walkways, and (2) creating an alternate path around the restricted area. In either case, signs should instruct those being diverted. Black and yellow rope or barricade tape should be tied between safety barricades to form a continuous barrier that warns, directs, and protects pedestrians.

c. For nighttime use, all safety barricades located near pedestrian walkways shall be equipped with flashing lights, unless high levels of illumination exist. When erecting safety barricades, evaluate each location for evidence of use by pedestrians and install flashing lights when necessary.

6. Additional information and guidance are available in 29CFR 1926, Subpart G and 29CFR 1910.145.

E. HOUSEKEEPING

1. No refuse shall be piled or allowed to accumulate at the work site, nor shall it hinder adjacent area work in progress or other Bettis operations. Passageways, stairs, walkways, and work areas shall be kept free of debris. Combustible scrap and debris shall be removed at the end of each workday.

2. Stored materials shall not block emergency equipment, aisles, doors, stairways, or exits.

3. Emergency equipment must be accessible at all times.

4. The Seller shall provide approved containers (with covers) for flammable wastes, oily rags, and hazardous wastes such as caustics, acids, and harmful dusts.

5. Projecting nails in scrap lumber shall be removed or bent down flush with the surface.

6. Oil, grease, dirt, and mud shall be removed from walking and working surfaces.

7. Additional information and guidance are available in 29CFR 1926.25.

F. PERSONAL PROTECTIVE EQUIPMENT

1. The following general rules apply to personal protective equipment:

   a. All protective equipment which is necessary to protect employees from any hazard which could cause injury or illness shall be maintained in a sanitary and reliable condition.

   b. Ensure that employees and visitors wear appropriate PPE when required.

   c. PPE shall meet accepted national standards and specifications such as American National Standards Institute.

   d. Defective or damaged PPE shall not be used.

2. Hearing protection (earplugs or muffs) shall be worn where noise exposure may exceed 85 dB(A) over an eight-hour time weighted average period. Some typical operations that require hearing protection are jackhammering, mechanical earth tamping, and working near some pumps and compressors. The Seller shall have a written hearing conservation program. See 29CFR 1926.52, 29CFR 1926.101, and 29CFR 1910.95 for additional information and guidance.

3. Hard hats shall be worn by employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns.

   a. Work in areas under the categories of new construction, major construction renovation, or demolition must be considered for hard hat protection if working conditions (b through e, below) warrant such protection.

   b. Working under or around scaffolding. Scaffolding shall be roped off at least five feet from each accessible side of scaffolding and posted as a "hard hat area" for entry.

c. Personnel located within the potential drop zone of a load being transported overhead by mechanical means.

d. Personnel within a few feet of overhead work which does not have protective screens, kick plates, or equivalent to prevent objects from falling, if such overhead work is at least eight feet above "ground" level.

e. Personnel working under equipment or material that presents a bumping hazard and when there is reasonable probability that injury can be prevented by the use of head protection.

4. Safety shoes are required for handling heavy materials and other operations where workmen are exposed to foot hazards. Workers in areas under construction, renovation, or demolition require safety shoes. Foot protection with metatarsal guards is required for jackhammering and earth tamping operations.

5. Eye and face protection is required when machines or operations present potential eye and face injuries from physical or chemical agents. Operations requiring eye and/or face protection include welding and cutting, grinding, chipping, jackhammering, handling hazardous chemicals, rotating power tools, hammering, banding or un-banding cartons or material, and rolling or unrolling wire or cables. Face shields alone do not provide adequate eye protection.

6. Respirators are required for operations that create excessive dust or hazardous vapors or fumes. Operations shall be evaluated to determine the need for respiratory protection. The type of respirator shall be suitable for the hazard involved. A Bettis approved "High Risk" safety plan, that is in accordance with ANSI Standard Z88.2 - latest edition, shall be used for operations requiring respirator protection. Also, the Material Safety Data Sheet (MSDS) must be reviewed for respirator requirements.

7. Safety harness, lifelines, lanyards and safety nets shall be used in accordance with 29CFR 1926 Subpart M. Also, see Section P on "Fall Protection." Work over six feet from the defined base shall be in accordance with an approved "Supplemental Safety Plan."

8. Additional information and guidance are available in 29CFR 1926, Subpart E and 29CFR 1910, Subpart I.

NOTE

As a minimum, the Seller shall provide and enforce utilization of personal protective equipment as needed.

G. FIRE PROTECTION AND PREVENTION

1. Personnel shall know the location of fire alarm boxes and emergency equipment such as fire extinguishers. Access to this equipment shall be kept clear.

2. Keep emergency exit paths clear at all times. Do not block fire doors either **open or closed**, and ensure that emergency signs on the doors are visible. Some fire doors are held open by devices that release the door automatically in a fire or smoke condition.

3. Keep clear access to extinguishers, hydrants, and Fire Department connections to sprinklers.

4. Non-compatible materials that may create a fire hazard shall be segregated by a barrier having a fire resistance of at least one-hour or separated by at least 20 feet.

5. Approved safety cans shall be used when handling and using flammable liquids in quantities greater than one gallon. For quantities of one gallon or less, only the original container or metal safety cans shall be used for storing, using, and handling flammable liquids. All containers must be labeled as to contents.

6. Flammable liquids shall be kept in closed containers when not actually in use.

7. Flammable or combustible fuel for the Seller's equipment shall be stored in a tank or container in accordance with the provisions of NFPA No. 30. If the temporary fuel storage tank capacity exceeds 660 gallons, the tank shall be located in accordance with the provisions of 40CFR 112, so as to prohibit the entry of fuel into the storm or sanitary drains in the event of a spill.

8. Cloth or paper that has been used or has been in contact with flammable or combustible liquids shall be placed in Oily Waste containers. Containers will be emptied daily. Oily Waste shall be removed from Bettis on a daily basis.

9. Post NO SMOKING signs (available from Bettis Stores) in areas where flammable vapors may be present, such as areas in which flammable liquids or gases are routinely used or stored.

10. The use of kerosene, gasoline, or propane-fueled heaters indoors is prohibited except for emergencies. Approval by Protection Systems is required to use such heaters indoors or in tents at Bettis.

11. The installation or modification of any system which includes the permanent piping of flammable gas from a cylinder into a building must be reviewed and approved by Protection Systems before the work is performed.

12. Special rules apply for the construction and use of portable or temporary structures. Refer to Appendix 4, "Bettis Fire Protection Requirements for Portable and Temporary Structures".

13. Additional information and guidance are available in 29CFR 1926, Subpart F and 29CFR 1910, Subpart L.

H. COMPRESSED GAS CYLINDERS

1. Cylinders shall be considered full unless labeled as empty, and shall be handled or used with corresponding caution.

2. Cylinders (regardless of size) whether in use, in storage, or in transit, shall be secured upright by chains, rigid retaining bars, vertical compartmented storage structures, or similar substantial devices to prevent cylinders from falling or being knocked over. Nonmetallic (i. e., combustible) web, rope, strapping, or similar materials and wire lashings are not acceptable for securing cylinders. This requirement does not apply to gas cylinders used in and for radiac instruments or to air-conditioner charging cylinders or to self-contained breathing apparatus cylinders or fire extinguishers being used by a fire watch.

3. Protective valve caps shall be in place on all gas cylinders in storage or transit, except for cylinders that are not equipped for caps. The cap shall remain on the cylinder until the gas is ready for use, and shall be replaced when the cylinder is empty or not in use.

4. A regulator or gage or a regulating manifold shall be used with gas cylinders. Regulators, gages, and manifolds are to be matched to the specific type of gas and the service for which the cylinders are being used. Adapters to connect cylinders of one type of gas to piping, manifolds, gages, or valves intended for other types of gases shall not be used. Do not use lubricants on valves or regulators or modify them in any way.

5. If a flammable or non-toxic cylinder leaks and the leak cannot be remedied by tightening a valve gland or packing nut, close the valve and move the leaking cylinder outside to a well-ventilated location. Notify the cognizant Bettis representative for the job and the Bettis Fire Marshal. If the gas is toxic, place an appropriate sign at the cylinder and rope off or barricade the area. Notify the cognizant Bettis representative and the Bettis Fire Marshal.

6. Cylinder contents shall be identified by means of a legible label or stencil or by identifying markings embossed on the cylinder by the supplier.

7. Cylinders shall not be subjected to a temperature above 125°F. A flame should never be permitted to come in contact with any part of a compressed gas cylinder. This does not apply to self-contained breathing apparatus cylinders in use by emergency personnel.

8. Compressed gas cylinders should not be dropped, bumped, or handled roughly. Cylinders are not to be used as rollers to move equipment or material. Caution shall be exercised to protect cylinders from sources that could cut or damage the metal surface.

9. Cylinder valves shall be closed when not in use. This is especially important at the end of the day's work or on "empty" cylinders.

10. It is a Bettis practice to store gas cylinders in racks and to provide weather protection for the cylinders and racks. Manifolded cylinders stored in outdoor locations shall be protected from the weather by lean-to roofs, manifold cabinets, or other means. Cylinders shall be protected from the ground beneath to prevent rusting. Cylinders shall not be stored at ambient temperatures above 125°F, and the supplier's recommendation for shading shall be observed.

11. Cylinder valves without fixed valve handles shall have keys or handles on valve stems while cylinders are in service to permit immediate emergency shutdown.

12. Storage areas and manifold installations for flammable gas cylinders shall have conspicuously posted signs warning against smoking, open flames, or open lights.

13. No flammable gas cylinders shall be used inside a building unless approved by Fire Protection personnel. Oxy-acetylene rigs are exempt from this requirement. Cylinders containing flammable or oxidizing gases inside buildings shall be stored at least 20 feet from combustible materials, and are not to be exposed to an excessive rise in temperature or physical damage.

14. Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials by a minimum distance of 20 feet or by a noncombustible barrier at least five feet high having a fire-resistance rating of at least 1/2 hour, as identified in the NFPA Codes.

15. Oxy-acetylene rigs for burning, cutting, or welding (comprised of one fuel gas cylinder, one-oxygen cylinder, attached hoses with pressure regulators) are exempt from the requirements of Item 14. However, oxy-acetylene rigs are required to be separated from each other and from fuel gas cylinders by a 20-foot minimum distance or by a noncombustible barrier at least five feet high having a fire-resistance rating of at least 1/2 hour.

16. Hydrogen cylinders shall not be used inside buildings unless authorized by the Fire Protection Engineer.

17. For transporting and moving gas cylinders, use a suitable hand truck, fork truck, roll platform, or similar device with the cylinder firmly secured. This requirement does not apply to radiac instrument cylinders, air conditioner charging cylinders, or self-contained breathing apparatus cylinders.

18. Hydrogen cylinder valves shall not be cracked to blow out dirt since hydrogen can self-ignite.

19. Acetylene cylinders shall be stored and used upright. Acetylene shall not be used at pressures greater than 15 pounds per square inch gage (psig).

20. Grease or oil shall not be used to lubricate valves or joints of compressed gas cylinders, especially oxygen cylinders.

21. Because oxygen under pressure may react violently with oil or grease, precautions shall be taken to prevent oxygen from coming into contact with oil or grease. Oxygen cylinders, valves, regulators, hose, and other apparatus shall be kept free from oil or grease and shall not be handled with oily hands, oily gloves, or with greasy equipment.

22. Additional information and guidance are available in 29CFR 1910.101, compressed gases (general requirements). Also, see 29CFR 1910, Subpart M.

I. HAND TOOLS

The use of hand tools shall meet the following requirements:

1. Tools shall be used for the applications for which they were designed. For example, screwdrivers shall **not** be used as chisels.

2. Tools shall be used with their proper handles. Split, cracked, or broken handles shall be replaced. Files are required to have handles when in use. Files in storage (on racks or in drawers) are not required to have handles.

3. Hand tools with mushroomed heads or excessively worn working surfaces shall be redressed or replaced.

4. Tools shall be stored in proper receptacles when not in use.

5. Tools shall be kept in safe operating condition, and shall be used in the proper manner.

6. When tools are used so that they are struck against one another (e.g. hammer and chisel) or when a tool is used for striking a surface, eye protection shall be worn.

7. When bars or other hand tools may contact underground electric power lines, insulated protective gloves and leatherwork gloves shall be worn.

J. POWER-OPERATED HAND TOOLS

1. Electric power tools shall be either double-insulated or grounded by means of a three-wire cord and three-prong plug. If double-insulated tools are used, they shall display the UL seal and shall be conspicuously marked "Double Insulated".

2. Gasoline or propane powered tools shall not be used inside buildings at Bettis unless specifically approved by the Safety Department and Protection Systems. Equipment with internal combustion engines can produce high levels of carbon monoxide. Protection Systems will review the fire protection for the area.

3. Powder-actuated tools are tools that use an explosive charge (normally powder) to drive studs, fasteners, or pins onto or into metal or other material or objects. These tools may be used at Bettis Site only with the written concurrence of the cognizant

Bettis representative. These tools shall meet the requirements on ANSI A10.3 and 29CFR 1910.243(d).

General Practices

(a) Eye and face protection shall be worn.

(b) Ear plugs and/or muffs shall be worn when the noise level is ≥85 dBA.

(c) Fasteners used in tools shall be only those specifically manufactured for use in such tools.

(d) Only personnel who have been trained in the operation of the tool shall be allowed to operate a powder-actuated tool.

(e) Before using a tool, the operator shall inspect it to determine to his satisfaction that it is clean, that all moving parts operate freely, and that the barrel is free from obstructions.

(f) Any tool found not in proper working order, or that develops a defect during use, shall be immediately removed from service and not used until properly repaired.

(g) All tools shall be used with the correct shield, guard, or attachment recommended by the manufacturer.

(h) Tools shall not be used in an explosive or flammable atmosphere.

(i) Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any worker, and hands should be kept clear of the open barrel end.

(j) An unattended tool shall not be left loaded.

(k) In case of misfire, the operator shall hold the tool in the operating position for at least 30 seconds. The operator shall then try to operate the tool a second time. If it does not operate, the operator shall wait another 30 seconds, holding the tool in the operating position. The explosive load shall then be removed in strict accordance with the manufacturer's instructions. Misfired cartridges should be placed carefully in a metal container filled with water, and then shall be disposed of in accordance with Environmental Engineering instructions.

(l) Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile.

(m) Driving into materials easily penetrated shall be avoided unless such materials are backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side.

(n) No fastener shall be driven into spalled areas of concrete which have been caused by an unsatisfactory fastening.

(o) Power loads of different power levels and types shall be kept in separate compartments or containers.

(p) The tool shall always be held perpendicular to the work surface when fastening into any material, except for specific applications recommended by the tool manufacturer.

The following rules apply during use, and adherence is required by the tool operator:

(a) Keep hands away from area being fastened.

(b) Never assume the tool is empty.

(c) Never engage in "horseplay" with the tool.

(d) Never carry the tool with your finger on, or depressing, the trigger.

(e) Never operate a tool that is malfunctioning.

4. Additional information and guidance are available on hand and power tools in 29CFR 1926, Subpart I and 29CFR 1910, Subpart P.

K. WELDING, BURNING, OPEN FLAME OPERATIONS

General

Bettis has approved areas where welding, burning or open flame operations are performed on a regular basis. A list of these areas is kept in the fire protection office.

Personnel performing or assisting in open-flame operations shall be protected by personal protective clothing required by 29 CFR 1910.252-(e)(2) and (3). Appropriate protective clothing required for these operations will vary with the size, nature and location of the work to be performed. Examples of protective clothing are: flame-resistant gloves, aprons, leggings, high boots; safety shoes; for overhead work, capes or similar garments of flame resistant material; eye protection including, but not limited to safety glasses, chipper's goggles, welder's goggles, welder's helmets, hand-shields, full-face shields, etc.; fire resistant jackets and trousers; and respiratory protection for the hazard involved. (NOTE: Any outside contractor doing electric arc welding or oxyacetylene cutting and burning needs a “supplemental safety plan”.)

When welding, burning or open flame soldering operations are performed outside of an area permanently designated for such operations, the precautions listed below shall be observed.

1. Obtain from the cognizant Bettis representative, a Welding/Burning Permit, Form 73756, before welding, burning, or open flame soldering operations are performed. The cognizant Bettis representative shall obtain the area manager's signature on the form.

2. Inform the cognizant Bettis representative, who shall notify the Bettis Fire Marshal and Fire Protection Engineer, of any welding, burning or open flame soldering operation when extraordinary conditions exist, such as the presence of explosives, pyrophoric materials, or flammable liquids or gases.

3. Where possible, flame resistant curtains, screens, blankets, or shields shall be erected to enclose a welding or burning area. Ensure that screens are large enough to prevent sparks or welding flashes from injuring personnel or starting fires in adjacent areas. The above fire resistant material shall be in good condition.

4. Appropriate fire extinguishing equipment such as garden hoses, sand, pails of water, or CO_2, dry chemical, or water fire extinguishers shall be "on-the-job" and available if needed. Notify the cognizant Bettis representative, who shall report to the Fire Marshal, the discharge of any fire extinguishers.

5. Contact the cognizant Bettis representative before welding, burning, or open flame soldering to ensure that area sprinkler systems are in working condition, and know the location of the nearest fire alarm box. No burning, welding, or open flame soldering is permitted when the sprinkler systems are out of service.

6. Completed Welding/Burning permits shall be returned to the cognizant Bettis representative within two days of the work date.

7. Assure that the proper respirators or ventilation controls are used when welding zinc-coated metals, lead, cadmium, stainless steel, or other material that may produce harmful fumes, dusts, or gases.

8. Move combustible materials beyond the reach of sparks, flames, hot slag, or molten metal. Cover combustible material that cannot be moved with non-combustible material.

9. Do not weld, burn or open flame solder near spray booths or containers that have held flammable materials, chlorinated hydrocarbons, Halon, or Freon. Depressurize and purge lines that contain flammable materials.

10. Electric welding machines shall be properly grounded and connections shall be secure before using this machine.

11. A firewatch shall be posted during welding, burning or open flame soldering operations. The fire watch shall remain at the job at least 30 minutes after the operator has finished. An inspection must be performed no sooner than 30 minutes after the operation is completed to assure the area is firesafe. The firewatcher's signature on the Welding/Burning Permit shall verify that the area is firesafe.

12. Before leaving, turn off welding, burning or open flame soldering equipment, shut off gas cylinder valves and release pressure from gas hoses.

13. Portable electrical welding units shall be unplugged when not in use, and the ground shall be disconnected.

14. Do not leave a torch or hose inside a tank or pit after welding, burning or open flame soldering is completed.

15. If welding is to be done on or near a wall, partition, ceiling or roof, precautions shall be taken to prevent ignition of combustibles on the other side of or in the wall.

16. The fire watch shall be trained in the use of the fire extinguishers used on the job.

17. The fire watch shall know the location of the nearest manual fire alarm pull box.

18. Compressed gas cylinders shall be stored and used in accordance with Section H of these Rules.

19. Additional information and guidance are available in 29CFR 1926, Subpart J and 29CFR 1910, Subpart Q.

Other Open Flame Operations

Other open flame operations include open flame work (other than welding, burning or open flame soldering) that is performed outside of an established and approved welding, burning or open flame soldering work area. The precautions below shall be observed to protect personnel from injury and property from damage.

a. Before the start of open flame operations, the operator shall know the location and use of the nearest fire extinguisher in the event the extinguisher is needed.

b. Move combustible materials (if possible) beyond the reach of the open flame work. Cover combustible materials that cannot be removed with non-combustible material.

c. The work area and adjacent areas to which sparks and heat might spread shall be inspected after each stoppage of work and shall be free of fire and/or smoke or other evidence of fire.

L. CHEMICAL SUBSTANCES (Hazard Communication)

1. All containers (liquids, solids, or gases) shall be identified as to contents by means of a label or stencil. Labels shall be in conformance with 29CFR 1910.1200 and contain health hazard information.

2. If containers of chemicals are located that are obviously old, decomposed or crystallized, notify the cognizant Bettis representative, who shall contact Safety Engineering. This requirement is especially applicable to ethers, picric, and perchloric acids.

3. Products that contain hazardous or acutely hazardous chemicals, as defined by OSHA, the EPA, or the Commonwealth of Pennsylvania, shall be approved by Bettis prior to use.

4. Material Safety Data Sheets (MSDS) for all hazardous products must be available on-site for unrestricted access for subcontractor personnel and for review by Bettis. The use of the personnel protective equipment that is listed on an MSDS is required when handling the product.

5. The use of products containing carcinogens or suspect carcinogens is not permitted when less toxic products are available.

6. Exposure to hazardous substances in excess of OSHA Permissible Exposure Limits (PELs) or ACGIH Threshold Limit Values (TLVs) is not permitted.

7. The Seller and its lower tier subcontractors must be in compliance with 29CFR 1926.59 and 29CFR 1910.1200, Hazard Communication Requirements.

8. The Seller's job supervisor is responsible for the on-the-job health and safety of his or her employees and visitors and for maintaining a healthful work environment. In fulfilling this health and safety responsibility, supervisors shall:

   (a) Train employees on the chemical and physical hazards associated with the materials in their work area. This training shall be conducted prior to exposure. The purpose of this training is to prevent employee exposure to hazardous working conditions.

   (b) Periodically instruct employees, through the use of workplace meetings or individual discussion, on precautions, procedures, and practices to eliminate accidental exposure to potentially harmful agents. This training is required whenever a new hazard is introduced to the workplace.

   (c) Make certain that edibles and tobacco are not stored or consumed in work areas where toxic materials may be present.

   (d) Promptly inform the cognizant Bettis representative of any operation or condition that appears to be a health hazard.

   (e) Inform Medical promptly in case of exposure to harmful agents.

   (f) Furnish employees with proper personal protective equipment, instruct them in its proper use, and enforce wearing of such equipment.

   (g) Inform each employee that he or she has an obligation to (1) notify his or her supervisor immediately when conditions or practices may cause personal injury or property damage, (2) observe all health and safety rules, (3) make maximum use of all prescribed personal protective equipment, (4) immediately report to his or her supervisor any accidental exposures to harmful agents, and (5) develop and practice good habits of personal hygiene and housekeeping.

9. The Seller is required to measure the employee's exposure to any regulated substance if there is reason to believe that exposure levels for that substance may exceed the Permissible Exposure Limit (PEL) or the action level. If monitoring results exceed the PEL or action level, further monitoring may need to be conducted.

10. See Appendix 8 for prohibited and restricted usage materials at the Bettis-Pittsburgh Laboratory.

11. Additional information and guidance are available in 29CFR 1910, Subparts H and Z. Also, see 29CFR 1926, Subpart D.

M. GENERAL ELECTRICAL SAFETY

1. General Rules and Precautions

a. Energized parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures by any of the following means:

(1) By locating the equipment in a room, vault, or similar enclosure that is accessible only to qualified persons.

(2) By suitable, permanent, substantial partitions or screens so arranged that only qualified persons will have access to the space within reach of the energized parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the energized parts or to bring conducting objects into contact with them.

(3) By locating the equipment on a suitable balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.

(4) By locating the equipment at an elevation of 8 feet or more above the floor or other working surface.

(5) In locations where electrical equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent physical damage.

(6) Entrances to rooms and other guarded locations containing exposed energized parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

b. Indoor electrical equipment that has been wet shall be shut off and then inspected by an electrician before power is restored. The electrician shall ensure that the equipment has not been damaged and is liquid-free prior to re-energizing the equipment.

c. Metal ladders, scaffolds, stepstools, etc., shall not be used for working on or with electrical equipment or near equipment that might energize the ladder, scaffold, etc.

d. The following types of apparatus are not permitted on the Bettis site:

(1) Two-conductor extension cords with two-prong plugs

(2) Extension cords with male plugs on both ends

(3) "Cheaters" (two-wire to three-wire adapters)

(4) Power cords that have been spliced

(5) "Octopus plugs"/"cube taps".

e. Notify the cognizant Bettis representative of electrical problems. Do not attempt to repair electrical equipment yourself unless addressed in your contract.

f. When possible, electrical equipment shall be de-energized and locked out (Appendix 5) before working on it. Assure that personnel are clear of affected equipment before energizing the circuit. Safety rules for tagging out electrical circuits or equipment are contained in Appendix 6.

g. Replace power cords on which the insulation is rotted, cut, cracked, or frayed. Power cords are not to be spliced or taped.

h. In locations where hazardous concentrations of flammable vapors or gases may be expected, electrical apparatus shall be explosion-proof.

i. High-voltage equipment operating at 600 volts or more shall have signs or stickers worded DANGER-HIGH VOLTAGE on access doors or panels. Such equipment includes instruments with high-voltage internals and equipment which either feeds from or generates high voltage. Relatively small units (such as modular power supplies and R-F generators) require only stickers, while larger units (such as cages containing transformers or other high-voltage equipment) are required to be posted with signs.

j. Portable electric lights used in wet locations (e.g., areas containing drums, tanks, and vessels) shall be operated at a maximum of 12 volts.

k. Temporary lights shall be equipped with guards to prevent the bulb from being broken.

l. See Section Y for requirements when jackhammering near possible under-ground electrical conduit or power-lines.

m. Because of concerns over the difficulty in insuring that circuits conform to the National Electric Code requirements no new installations are allowed which incorporate multi-wire branch circuits.

n. Branch circuit switches inside distribution panels shall be labeled to indicate their purpose.

o. Electrical "knockouts" shall not be left open when not in use. Knockout plugs shall be installed.

p. Metal "handy boxes" or metal junction-type outlet boxes with knockout-style openings shall not be attached to extension cords. These boxes are designed for use as rigid mounted outlet boxes only.

2. Grounding Requirements

a. All exposed, non-current-carrying, metal parts of portable and fixed equipment operated at 50 volts or higher if those parts are liable to become energized under abnormal conditions shall be grounded, except:

1. Office equipment - New office equipment shall have a three-conductor power cord with a three-prong plug for proper ground. Existing office machines should have a grounded power cord and plug installed when the equipment undergoes major repairs. Office machines that are double insulated need not be grounded.

2. Vibratools without motors

3. Clocks

4. Soldering irons (less than 300 watts)

5. Desk type lamps (newly procured lamps must be grounded)

6. Small household appliances (e.g. small coffee pots, radios, etc.)

7. Hand-held calculator chargers.

For items not exempted above, but that you consider need not be grounded, contact Safety Engineering for resolution. The exceptions cited above are **not** valid if the equipment is used in damp, wet, or conductive locations.

b. Ground Fault Circuit Interrupters (GFCIs) shall be used on all Bettis construction operations. This requirement applies to all construction subcontractor activities.

3. Qualified Electrical Worker

A qualified electrical worker is a person who performs electrical work at the Bettis Site and is knowledgeable of the construction and operation of the equipment involved and of the hazards associated with the work. The supervisor of every worker is responsible to ensure that the worker is in all respects knowledgeable to perform the assigned electrical work. A qualified electrical worker is the only person that can work on electrical circuits or equipment.

Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

4. Qualified Electrical Worker Training

The supervisor of each qualified electrical worker shall ensure that refresher training is given at least annually. In addition, those workers permitted to work on or near exposed energized parts shall, at a minimum, be trained in and be familiar with the following:

(1) the skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;

(2) the skills and techniques necessary to determine the nominal voltage of exposed live parts; and

(3) the clearance distances specified in 29CFR §1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

This training shall be provided to all electricians, electronic technicians, and any other personnel who work with electricity or electronics at Bettis and have been declared a qualified electrical worker by their management. See Table S-4 in 29CFR 1910.332 for typical occupations facing a higher-than-normal risk of electrical accidents.

This training shall be classroom and on-the-job training. The degree of training provided shall be determined by the risk to the employee as determined by his or her supervisor.

5. Training for Unqualified Persons

Any unqualified person who must work on or near installations addressed in 29CFR 1910.331 must also receive electrical worker training addressed in Section M.4 above. In addition, these persons shall be trained in and be familiar with any electrically related safety practices which are necessary for their safety.

6. Safety-Related Work Practices

Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.

7. De-energized Parts

Live parts to which an employee may be exposed shall be de-energized before the employee works on or near them, unless it can be demonstrated that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

The circuits energizing the parts shall be locked and tagged in accordance with Appendices 5 and 6 of this manual.

8. Working on De-energized Electrical Circuits and Equipment

Any electrical repairs, modifications, installations, additions or alterations shall be performed in the de-energized state as far as practicable. When work must be performed on energized electrical circuits or equipment the requirements in Section M.11 shall apply.

a. De-energization shall be accomplished by physically tracing all possible energization paths, de-energizing such paths, and using the lockout and tag-out procedures of Appendices 5 and 6 to prevent re-energization.

b. De-energized circuits shall be treated as if they were energized until it is positively proven that they are dead. Such circuits shall be tested with an appropriate voltage tester to assure that they are de-energized. Test the voltage tester on a voltage source of about the same value as the circuit to be tested. Then test the circuit to see if it is actually dead. Then retest the voltage tester. The removable test leads on the portable meters must be securely connected to the meter when in use.

c. De-energize circuits near the equipment being worked on if there are possible contacts for dropped tools, test leads, or inadvertent body contact. Work is considered 'near' energized circuits if the worker or any tools could accidentally contact such circuits while performing the task. If nearby circuits cannot be de-energized, they shall be covered with insulating material so that contact cannot be made. If nearby energized circuits cannot be de-energized or covered, then the requirements specified in Section M.11 shall apply.

d. Before power is applied to circuits for the first time after an installation, alteration, or repair, the responsible supervisor, or a worker delegated by the supervisor, shall make a complete check of the circuit to ensure safe operation. Examples of electrical checks that shall be performed include:

(1) Point-to-point wire checks;
(2) Wiring diagram comparison checks;
(3) Visual checks to verify proper case grounding;
(4) *Line-to-line, line-to-neutral, and line-to-ground resistance checks (megger); and
(5) Ohm meter check to verify proper cabinet and/or case grounding.

* Portions of the circuit may need to be isolated before performing megger checks.

9. Electronic, Bench-Type Electrical Work

Any electrical repairs, modifications, installations or alterations performed on electronic circuits or instruments operating at > 50 volts shall conform to the requirements of this section. Note that some types of fieldwork may also fall into this category. This type of work is exempt from the requirements in Sections M.10 and M.11.

a. Work shall be performed in a de-energized state as far as practicable.

b. Electronics work shall be performed by Qualified Electrical Workers (as defined in Section M.3).

c. If soldering is involved safety glasses shall be worn. This also applies to persons working near someone who is soldering. Side shields are required.

d. Intentionally taking a shock at any voltage is forbidden.

e. Circuits or equipment that contain capacitors or similar equipment with high values of capacitance can be dangerous and should be discharged twice before work commences. The capacitors shall be disconnected from the energizing source, if possible, short-circuited and grounded. Any line to which capacitors are connected shall be short-circuited and grounded using a shorting probe or bar before it is considered de-energized. The internal bleed resistor shall not be depended upon to discharge capacitors. Shorting leads shall remain connected to capacitors until all work is completed.

f. When a fuse blows, it shall be replaced with a fuse of the same rated voltage, and ampere capacity and type (i.e., slow-blow, fast acting, etc.).

g. Work shall be performed on a non-conductive surface as far as practicable.

h. The chassis and frame of power supplies and high voltage units removed for servicing shall be grounded, and all circuits normally grounded in operation shall be grounded before power is applied to the unit.

i. Each and every step of electrical work cannot be outlined in procedural format. Therefore, it is the responsibility of qualified electrical workers (QEW) to use good judgment to ensure wires, leads, cables, etc. are isolated from energized systems during electrical work. The QEW must take the necessary actions to ensure that this possibility is controlled by either insulating or adequately restraining these items from making contact with energized systems.

j. Make sure that the connections of removable test leads on portable meters are tight. The free end of an energized test lead which comes adrift from its meter during a check of live circuits is a shock and fire hazard. Alligator clips shall be equipped with insulating sleeves.

10. Trouble-shooting Electrical Circuits and Equipment

Trouble-shooting is defined as an activity performed by a Qualified Electrical Worker (see Section M.3) in which a defect in circuitry or equipment operating at > 50 volts is being sought. Trouble-shooting shall be performed in the de-energized state as far as practical. The following applies to trouble-shooting:

a. Use a calibrated voltage meter or check the meter on a known live circuit prior to use.

b. The sleeving on Voltmeter, Ohmeter or Ammeter alligator clips shall be visually inspected prior to each use.

c. If a voltage tester is used, it shall be tested on a known live circuit to verify that it is operating properly.

d. Do not wear finger rings, bracelets, watches, metal chains, or other metal articles that might come in contact with electrical circuits. See Section M.23.

e. Interlocks may be overridden only if it is essential to do so as part of the trouble-shooting effort. See Section M.18.

f. De-energize circuits near the equipment being worked on if there are possible contacts for dropped tools, test leads, or inadvertent body contact. If nearby circuits cannot be de-energized, they shall be covered with insulating material so that contact cannot be made.

g. Where work is to be performed on or near exposed energized circuits or equipment, at least one other person shall be present in the immediate area within visual contact. If it is necessary for one worker to leave for any reason, all work shall be discontinued until at least two workers are again present.

h. When practicable, only one hand shall be used in accomplishing the work.

i. The circuit breaker servicing the circuit or equipment should be located prior to the start of work, so that the circuit may be de-energized quickly if required.

j. Intentionally taking a shock at any voltage is forbidden.

k. Eye and face protection shall be worn when working on energized equipment such as switchboards where a short circuit could produce a high fault current capable of producing flying molten particles and intense heat. See Section M.29.

l. Provide ample lighting. See Section M.19.

m. Consider all electrical circuits to be dangerous. Contact with low voltages (< 50 volts) has caused workers to fall from ladders and scaffolds.

n. Each and every step of electrical work cannot be outlined in procedural format. Therefore, it is the responsibility of qualified electrical workers (QEW) to use

good judgment to ensure wires, leads, cables, etc. are isolated from energized systems during electrical work. The QEW must take the necessary actions to ensure that this possibility is controlled by either insulating or adequately restraining these items from making contact with energized systems.

o. Make sure that the connections of removable test leads on portable meters are tight. The free end of an energized test lead which comes adrift from its meter during a check of live circuits is a shock and fire hazard. Alligator clips shall be equipped with insulating sleeves.

11. Working On or Near Energized Electrical Circuits or Equipment

When the situation requires that work be done and circuits or equipment operating at > 50 volts cannot be de-energized, extreme measures of precautions must be used. The work shall be accomplished by a Qualified Electrical Worker (see Section M.3) fully cognizant of the dangers involved. When the potential for electric shock exists, every care shall be taken to insulate the person performing the work from ground. Work on energized equipment may be performed only if emergency repairs are necessary or if the nature of the work requires circuits to be energized. An example of working on energized circuits or equipment is splicing into an energized circuit. For any work on energized circuits, the following requirements apply. This rule is intended for electricians rather than electronic technicians.

a. Prior to beginning work on energized circuits or equipment, the area manager must be informed of the work to be performed.

b. Where work is to be performed on energized circuits or equipment, at least one other person shall be present in the immediate area within visual contact. If it is necessary for one worker to leave for any reason, all work shall be discontinued until at least two workers are again present, except such work as can be done outside any danger zone.

c. In considering what protective equipment and covering should be used, care should be taken to insulate the person performing the work from ground and to prevent the inadvertent touching of other energized circuits not being worked on. Where possible, barriers with appropriate warning signs should be installed to keep those not engaged in the repair or service work at least 4 feet away from any exposed, energized circuits. See Section M.31.

d. Electrical interlocks on equipment shall not be bypassed, repositioned, or overridden unless formal approval has been given by the responsible supervisor and Safety Engineering. Depending upon the nature and extent of work to be done, a written procedure may be required. After the work has been completed, (1) return the interlock to service, (2) check operation of the interlock to ensure it is operational, and (3) notify the responsible manager and Safety Engineering that the above actions have been taken.

e. When practicable, only one hand shall be used in accomplishing the work.

f. An electricians's rubber glove shall be worn on the hand not used for handling tools. Gloves shall be worn on both hands if the loss of dexterity would not result in problems.

g. The circuit breaker servicing the circuit or equipment shall be located prior to the start of work, so that the circuit may be de-energized quickly if required.

h. Provide ample illumination. See Section M.19.

i. The person doing the work shall not wear a wrist watch, rings, watch chain, metal articles, or loose clothing which might make accidental contact with energized parts or which might accidentally catch and throw some part of his body into contact with energized parts. Clothing and shoes shall be as dry as possible. See Section M.23.

j. The worker shall be insulated from ground by insulating material covering any adjacent grounded metal or other conductive surfaces he or she might contact.

k. De-energize or provide insulating barriers between the work and any metal parts immediately adjacent to the work to be done.

l. Eye and face protection shall be worn when working on energized equipment such as switchboards where a short circuit could produce a high fault current capable of producing flying molten particles and intense heat. See Section M.29.

m. Make sure that the connections of removable test leads on portable meters are tight. The free end of an energized test lead which comes adrift from its meter during a check of live circuits is a shock and fire hazard. Alligator clips shall be equipped with insulating sleeves.

n. Intentionally taking a shock at any voltage is forbidden.

o. Each and every step of electrical work cannot be outlined in procedural format. Therefore, it is the responsibility of qualified electrical workers (QEW) to use good judgment to ensure wires, leads, cables, etc. are isolated from energized systems during electrical work. The QEW must take the necessary actions to ensure that this possibility is controlled by either insulating or adequately restraining these items from making contact with energized systems.

To assure that appropriate precautions are taken when work is being done on energized circuits, a "supplemental safety plan” and checklist for working on energized electrical equipment shall be completed by the electricians performing the work and their supervisor. (See Appendix 1).

Recognize that electrical diagrams attached to electrical equipment by the vendor are usually not updated to incorporate changes.

12. Deactivation of Electrical Service

Deactivation is the physical disconnection and removal of electrical power to a piece of equipment, panel, or area. This is distinguished from de-energization, which is the temporary interruption of electrical power by locking and tagging open breakers or switches. Deactivation shall be performed only by qualified electrical workers.

If the deactivation involves, or will be followed by, interfaces with other organizations, such as subcontractors or a phased deactivation, the Procedure for Utility Deactivation (PUD) (Appendix 2) shall be used.

Deactivated wiring, and devices, which are not immediately removed, should be left in a condition which is in accordance with applicable regulations, (e.g., wires taped and left in a box or wireway; wiring should not be left extended from the end of conduit).

13. Temporary Wiring

Bettis follows the rules for temporary wiring as addressed in Article 305 of the National Electric Code (NFPA 70). All feeders and branch circuits shall be protected as provided in Article 240 (Overcurrent Protection) of the NEC. All grounding shall conform to Article 250 of the NEC. Major requirements are outlined below, consult the NEC for additional guidance as necessary.

a. Temporary electrical power and lighting installations shall be permitted during the period of construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities.

b. Temporary electrical power and lighting installations shall be permitted during emergencies and for tests, experiments, and developmental work that are short term in duration (i.e., planned for months not years).

o. Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

d. All receptacles shall be of the grounding type. Unless installed in a continuous grounded metal raceway or metal-covered cable, all branch circuits shall contain a separate equipment-grounding conductor and all receptacles shall be electrically connected to the equipment-grounding conductors. Receptacles on construction sites shall not be installed on branch circuits that supply temporary lighting. Receptacles shall not be connected to the same ungrounded conductor of multi-wire circuits that supply temporary lighting.

e. Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit. Multi-wire branch circuits shall be provided with a means to disconnect simultaneously all ungrounded conductors at the power outlet or panelboard where the branch circuit originated. Approved handle ties are permitted.

f. All lamps for general illumination shall be protected from accidental contact or breakage by a suitable fixture or lampholder with a guard.

g. Brass shell, paper-lined sockets, or other metal-cased sockets shall not be used unless the shell is grounded.

h. Flexible cords and cables shall be protected from accidental damage. Sharp corners and projections shall be avoided. When passing through doorways or other pinch points, protection shall be provided to avoid damage.

i. All 125 volt, single-phase, 15- and 20-ampere receptacle outlets that are not a part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection.

j. For temporary wiring over 600 volts, nominal, suitable fencing, barriers, or other effective means shall be provided to prevent access of other than authorized and qualified personnel.

14. Overhead Lines

If work is to be performed near overhead lines, the lines shall be de-energized and grounded, or other protective measures shall be provided before work is started. If the lines are to be de-energized, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to de-energize and ground them. If protective measures are provided such as guarding, isolating, or insulating, these precautions shall prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.

15. Unqualified Person(s)

When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

(1) For voltages to ground 50 kV or below - 10 ft. (305 cm); and

(2) For voltages to ground over 50 kV - 10 ft. (305 cm) plus 4 in. (10 cm) for every 10 kV over 50 kV.

When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given above.

16. Qualified Person(s)

When a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table S-5 of 29CFR 1910.333 unless:

(1) the person is insulated from the energized part (gloves, with sleeves if necessary, rated for the voltage involved); or

(2) the energized part is insulated from all other conductive objects and from the person; or

(3) the person is insulated from all conductive objects at a potential different from that of the energized part.

17. Vehicular and Mechanical Equipment

Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50 kV, the clearance shall be increased 4 in. (10 cm) for every 10 kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

(1) If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50 kV, the clearance shall be increased 4 in. (10 cm) for every 10 kV over that voltage.

(2) If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

(3) If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the un-insulated portion of the aerial lift and the power line) may be reduced to the distance given in Table S-5 of 29CFR 1910.333.

Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

(1) The employee is using protective equipment rated for the voltage; or

(2) The equipment is located so that no un-insulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in Section M.15.

If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

18. Interlocks

Only a qualified person following the requirements for working on or near exposed energized parts may defeat an electrical safety interlock, and then only temporarily while working on the equipment. The interlock system shall be returned to its operable condition as soon as this work is completed. See Section M.11.d.

19. Illumination

Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas that may contain energized parts.

20. Confined Spaces

When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts. See Section T for more detailed information on confined space entry.

21. Conductive Materials and Equipment

Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in an area with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

22. Portable Ladders

Portable ladders shall have non-conductive side-rails if they are used where the employee or the ladder could contact exposed energized parts.

23. Conductive Apparel

Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal head gear) may not be worn if they might contact exposed energized parts.

24. Housekeeping

Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of

contact, unless adequate safeguards (such as insulating equipment or barriers) are provided.

Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

25. Portable Electric Equipment

This section applies to the use of cord- and plug-connected equipment, including flexible cord sets (extension cords). Portable equipment shall be handled in a manner that will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.

Portable cord- and plug-connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). Cord- and plug-connected equipment and flexible cord sets (extension cords) which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated.

If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

When an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configurations.

A flexible cord used with grounding-type equipment shall contain an equipment-grounding conductor.

Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.

Adapters that interrupt the continuity of the equipment-grounding connection may not be used.

Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations.

Employees' hands may not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment, if energized equipment is involved.

Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand (if, for example, a cord connector is wet from being immersed in water).

Locking-type connectors shall be properly secured after connection.

26. Electric Power and Lighting Circuits

Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in an emergency.

After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual re-closing of circuit breakers or re-energizing circuits through replaced fuses is prohibited.

When it can be determined from the design of the circuit and the over-current devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is re-energized.

Over-current protection of circuits and conductors may not be modified, even on a temporary basis, beyond that allowed by 29CFR 1910.304(e).

27. Test Instruments and Equipment

Only qualified persons may perform testing work on electric circuits or equipment.

Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

Test instruments and equipment and their accessories shall be rated for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used.

28. Occasional Use of Flammable or Ignitable Materials

Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous

conditions from developing. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flyings.

Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in 29CFR 1910.307.

29. Use of Personal Protective Equipment (PPE)

Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. See Section F for additional information on PPE.

(1) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested.

(2) If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. (For example, an outer covering of leather is sometimes used for the protection of rubber insulating material.)

(3) Electrically insulated rubber gloves shall be of appropriate voltage rating for the work being performed, be tested at appropriate voltage levels at intervals not exceeding six months, and be uniquely identified by serial number or other marking. Records of the most recent dielectric test shall be maintained.

(4) Employees shall wear non-conductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.

(5) Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

30. Use of General Protective Equipment and Tools

When working near exposed energized conductors or circuit parts, each employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

(1) Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.

(2) Ropes and hand-lines used near exposed energized parts shall be non-conductive.

(3) Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts which might be

accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

31. Alerting Techniques for Warning Personnel

Alerting techniques shall be used to warn and protect employees from hazards that could cause injury due to electric shock, burns, or failure of electric equipment parts. See Section D for additional information on signs, tags, and barricades.

Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that may endanger them.

Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to un-insulated energized conductors or circuit parts. Conductive barricades may not be use where they might cause an electrical contact hazard.

If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees.

32. See 29CFR 1926, Subpart K and 29CFR 1910, Subpart S for additional electrical requirements.

N. LADDERS, STAIRWAYS, AND SCAFFOLDS

1. Definitions

a. Cleat: A crosspiece of rectangular cross section placed on edge upon which a person may step while ascending or descending a ladder (a.k.a. rung, step).

b. Competent person: A person capable of identifying hazardous or dangerous conditions and defects in ladders or stairways, and their respective fall protection systems.

c. Fixed ladder: One that cannot be readily moved or carried because it is an integral part of the building or structure. The minimum clear distance between side rails for all fixed ladders shall be 16 inches.

d. Ladder: An appliance, usually consisting of two side rails joined at regular intervals by crosspieces called steps, cleats, or rungs, upon which a person may step in ascending or descending.

e. Portable ladder: One that can be readily moved or carried. Steps should be no less than 10 inches, or more than 14 inches apart. The minimum clear distance between side rails for all portable ladders shall be 11½ inches.

f. Stepladder: A self-supporting portable ladder, non-adjustable in length, having flat steps and a hinged back. Each stepladder shall be equipped with a metal

spreader or locking device to hold the front and back sections in the open position when the ladder is in use.

g. Step stool (ladder type): A self-supporting, foldable, portable ladder, non-adjustable in length, 32 inches or less in overall size, with flat steps and without a pail shelf, designed to be climbed on the ladder top cap as well as all steps. Steps should be no less than eight, or more than 12, inches apart.

2. General Requirements

a. A stairway or ladder shall be provided at all personnel points of access where there is a break in elevation of 19 inches or more, and where no ramp, runway, sloped embankment, or personnel hoist is provided.

b. Ladders and stairways procured or built for use at the Laboratory shall meet or exceed the requirements of the applicable Subpart in 29 CFR Part 1910 or 1926 (OSHA).

c. The Laboratory standard for portable ladders is industrial (i.e. Type I or IA).

d. Ladder rungs, cleats, and steps shall be parallel, level, and uniformly spaced when the ladder is in position for use.

e. Portable, straight, and extension ladders shall be equipped with slip-resistant feet. Stepladders shall have slip-resistance feet on the front legs.

f. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used on an unavoidably slippery surface (e.g. flat metal or concrete).

g. Wood ladders may be coated with a transparent, non-conductive finish such as varnish, shellac, or a clear preservative. Wood ladders shall not be coated with any opaque covering, except for identification or warning labels that may be placed on the side rail.

h. Portable metal step stools and wheeled staircases shall be stenciled or labeled by the manufacturer or the end user in a conspicuous and permanent manner as follows: CAUTION - DO NOT USE NEAR ELECTRICAL EQUIPMENT.

i. All parts of stairways, stair rail systems, and handrails shall be surfaced to prevent injuries to employees from punctures or lacerations, and to prevent snagging of clothing. The ends of stair rail systems shall not constitute a projection hazard.

j. Handrails and the top rails of stair rail systems shall be capable of withstanding, without failure, a force of at least 200 pounds applied within two inches of the top edge, in any downward and outward direction, at any point along the top edge.

k. Requirements for fixed ladders including, but not limited to, clearances, cages, wells, and ladder safety devices, are addressed in 29 CFR 1926 Subpart X.

l. Portable straight ladders in use shall be tied, blocked, or otherwise secured to prevent their being displaced.

m. Job-built ladders, whether for construction or maintenance service, shall meet the standards of 29 CFR 1926 Subpart X.

n. Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds.

o. Ladders shall not be placed on boxes, barrels, or other unstable bases to obtain additional height.

p. Fall protection is required when working greater than six feet from the bottom of straight, extension, or fixed ladders.

q. Additional information and guidance are available in 29 CFR 1926 Subpart X and in 29 CFR 1910 Subpart D.

3. Inspection Requirements

a. All ladders shall be maintained in a safe condition. Competent persons shall inspect all ladders for visible effects on a periodic basis and after any occurrence that could affect their safe use.

b. Personnel who use portable ladders shall inspect the portable ladders before each use for compliance with the manufacturer's care and use instructions. If the care and use instructions are damaged or otherwise unavailable, the inspection checklist below shall be used.

c. Unsafe and/or defective ladders shall be immediately marked in a manner that readily identifies the ladder as defective, and shall be removed from service until the defect is repaired.

4. Care and Use of Portable Ladders

a. A portable ladder's side rails shall extend at least three (3) feet above the landing surface it is used to access. When this extension cannot be met, the ladder shall be secured at its top to a rigid support that will not deflect, and a grab rail shall be installed to assist employees in mounting and dismounting.

b. Ladders shall have non-conductive side rails if they are used where the employee or the ladder could contact exposed energized electrical equipment, except as may be necessary in specialized work where non-conductive ladders might present a greater hazard than conductive ladders.

c. Ladders shall not be loaded beyond the maximum intended load for which they were built, or beyond the manufacturer's rated capacity.

d. Non-self-supporting ladders shall, where possible, be used at an angle such that the horizontal distance from the top support to the foot of the ladder is one-

fourth of the working length of the ladder (the length along the ladder between the foot and the top support).

e. Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement. Levelers should be installed when necessary.

f. All ladders, except stepladders or platforms that can be displaced by workplace activities or traffic, shall be secured to prevent accidental displacement and the area posted to alert pedestrians. When necessary, barricades shall be installed to keep those activities away from the ladder. Ladders shall not be placed in front of doors opening toward the ladder unless the door is blocked open, locked, or guarded.

g. Both rails at the top of a non-self-supporting ladder shall be supported equally unless it is equipped with a single support attachment.

h. Ladders shall not be moved, extended, or shifted while occupied.

i. Only one person shall be on a ladder at any time except ladders designed as two-person working load products.

j. When ascending or descending, the user shall face the ladder and shall grasp the ladder with at least one hand at all times.

k. An employee shall not carry any object or load that could cause the employee to lose balance and fall. Tool belts and holsters should be used. Larger objects should be hoisted to the working level using a hand line or combination hand line and tool bag.

l. While working from a ladder, the worker shall maintain his or her body's center of gravity between the side rails at all times. Whenever the worker must violate this rule, use of a temporary work platform (i.e. scaffold) and/or fall protection shall be evaluated by person(s) competent in scaffolds and fall protection.

m. The rear side of stepladders shall not be used for climbing unless the ladder is designed and provided with steps for this purpose.

n. Ladders shall be maintained free of oil, grease, and other slipping hazards.

o. Wood ladders, when not in use, shall be stored where they are protected from adverse weather conditions. They shall not be stored near radiators, steam pipes, or in places subjected to excessive heat or dampness.

p. Ladders stored in a horizontal position shall be supported at several points to avoid sagging and permanent set.

q. Ladders carried on vehicles shall be supported to avoid sagging, and be securely fastened.

5. Training Requirements

a. Training requirements for ladder and stairway users engaged in construction, alteration, and/or repair work include:

(1) Hazard recognition and minimization;

(2) Nature of fall hazards in assigned work areas;

(3) The correct procedures for erecting, maintaining, and disassembling fall protection systems;

(4) Proper construction, use, placement, and care in handling of all stairways and ladders;

(5) Maximum intended load-carrying capacities of ladders used;

(6) The standards contained in this section; and

(7) Retraining as necessary to ensure personnel maintain acquired understanding and knowledge.

6. Scaffolds

a. General

(1) Scaffolds built and used at the Laboratory shall conform to 29 CFR 1926 Subpart L and applicable manufacturer's care, use, and safety instructions.

(2) A competent person shall be assigned to supervise scaffold erection, dismantling, alteration, and movement.

(3) Suitable barricades with postings shall be erected to (1) warn personnel of the hazards present, and (2) prevent personnel from passing beneath elevated work. Where possible, the barricade should be constructed "D" feet from the scaffold, where "D" equals one-third (1/3) of the vertical height of the work platform.

(4) All scaffold materials, including scaffold planking, shall be thoroughly inspected for defects prior to use. Defective materials shall be removed from service.

(5) Where fall protection systems such as guardrail systems cannot be installed, a person competent in personal fall protection systems shall evaluate the fall hazard and anchorage points, and recommend necessary fall protection equipment. The necessary equipment shall be provided and all workers shall be properly trained in its care and use.

(6) Scaffolds and their components shall be capable of supporting without failure at least four times the maximum intended load.

(7) When two scaffolds are used together, planking or platforms shall be overlapped (minimum 12 inches) and be secured from movement.

(8) Scaffold planks shall extend over their end supports not less than six inches and not more than 12 inches.

(9) When a scaffold is erected over a way of pedestrian or vehicular travel, an area of suitable size below the scaffold shall be posted "CAUTION - Men Working Above," and shall be roped off to prevent access to the area.

(10) Install wire mesh or equivalent from toe board to top rail when persons walking/working beneath.

(11) Lock wheels on rolling scaffold before use.

(12) Remove all workers before moving rolling scaffolds.

(13) Use hand line and tool bag for hoisting.

(14) A safe means of access shall be provided for each employee erecting or dismantling a scaffold where the provision of safe access is feasible and does not create a greater hazard. A competent person shall determine whether it is feasible or creates a greater hazard.

(15) Hook-on or attachable ladders or equivalent shall be installed as soon as scaffold erection has progressed to a point that permits safe installation and use.

(16) A competent person shall determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds. Fall protection shall be provided when such protection is feasible and does not create a greater hazard.

(17) Guardrail systems shall be installed along all open sides and ends. The guardrail system shall be installed before the scaffold is released for use by employees other than erection/dismantling crews.

(18) Where tools, materials, or equipment are piled to a height higher than the top edge of the toe-board, paneling or screening extending from the toe-board or platform to the top of the guardrail shall be erected for a distance sufficient to protect employees below.

(19) When the platforms are being moved to the next level, the existing platform shall be left undisturbed until the new bearers have been set in place and braced prior to receiving the new platforms.

b. <u>Inspections</u>

(1) Competent persons shall inspect erected scaffolds and any defects shall be corrected prior to releasing the scaffold for work.

(2) Daily inspections of all scaffolds and scaffolding work shall be conducted by competent persons, cognizant supervisors, or follow engineers.

(3) Scaffolds erected where the working platform is 15 feet or higher must be accompanied by the inspection checklist found in Appendix 7 of this manual.

c. Training

(1) Each employee who performs work while on a scaffold shall be trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards.

The training shall include the following:

(a) the nature of any electrical hazards, fall hazards, and falling object hazards in the work area;

(b) the correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems being used;

(c) the proper use of the scaffold, and the proper handling of materials on the scaffold;

(d) the maximum intended load and the load-carrying capacities of the scaffolds used; and

(e) any other pertinent requirements.

(2) Each employee who is involved in erecting, disassembling, moving, operating, repairing, maintaining, or inspecting a scaffold shall be trained by a competent person to recognize any hazards associated with the work in question.

The training shall include the following:

(a) the nature of scaffold hazards;

(b) the correct procedures for erecting, disassembling, moving, operating, repairing, inspecting, and maintaining the type of scaffold in question;

(c) the design criteria, maximum intended load-carrying capacity and intended use of the scaffold; and

(d) any other pertinent requirements of this subpart.

(3) When the supervisor or competent person has reason to believe that an employee lacks the skill or understanding needed for safe work involving the erection, use, or dismantling of scaffolds, the employer shall re-train each such employee so that the requisite proficiency is regained. Re-training is required in at least the following situations:

(a) where changes at the work site present a hazard about which an employee has not been previously trained;

(b) where changes in the types of scaffolds, fall protection, falling object protection, or other equipment present a hazard about which an employee has not been previously trained; or

(c) where inadequacies in an affected employee's work involving scaffolds indicate that the employee has not retained the requisite proficiency.

(4) "Supplemental Safety Plans" shall include employee and sub-tier training records to document compliance with the above-listed training requirements. (NOTE: Additional information on scaffold requirements can be found in 29 CFR 1926 Subpart L.)

O. AERIAL LIFTS

1. Aerial lifts include the following types of vehicle-mounted aerial devices used to elevate personnel to job sites above ground:

   a. extensible boom platforms;
   b. aerial ladders;
   c. articulating boom platforms;
   d. vertical towers; and
   e. a combination of any of the above.

2. General

   a. Ensure operator(s) are trained, competent, and authorized, including being familiar with operating and use instructions.

   b. Conduct a pre-use inspection.

   c. Ensure operating and use instructions are kept in the lift.

   d. Erect barricades and post the hazard area to warn of the hazards present and to prevent personnel from passing beneath elevated work.

   e. Belting off to an adjacent pole, structure, or equipment while working from an aerial lift shall not be permitted.

   f. Employees shall always stand firmly on the floor of the basket, and shall not sit or climb on the edge of the basket or use planks, ladders, or other devices.

   g. A harness shall be worn and a lanyard attached to the boom or basket when working from an aerial lift.

   h. Boom and basket load limits specified by the manufacturer shall not be exceeded.

i. The brakes shall be set and when outriggers are used, they shall be positioned on pads or a solid surface. Wheel chocks shall be installed before using an aerial lift on an incline, provided they can be safely installed.

j. An aerial lift truck shall not be moved when the boom is elevated in a working position with men in the basket, except for equipment which is specifically designed for this type of operation.

k. Articulating boom and extensible boom platforms, primarily designed as personnel carriers, shall have both platform (upper) and lower controls. Upper controls shall be in or beside the platform within easy reach of the operator. Lower controls shall provide for overriding the upper controls. Controls shall be plainly marked as to their function. Lower level controls shall not be operated unless permission has been obtained from the employee in the lift, except in case of emergency.

l. The insulated portion of an aerial lift shall not be altered in any manner that might reduce its insulating value.

m. Before moving an aerial lift for travel, the boom(s) shall be inspected to see that it is properly cradled and outriggers are stowed.

n. Do not use aerial lifts as material handling equipment.

o. Additional information on aerial lifts can be found in 29 CFR 1926.453.

P. FALL PROTECTION

1. Purpose and Scope

This section establishes the requirements and criteria for fall protection during construction and/or maintenance work. Personnel making an inspection, investigation, or assessment of workplace conditions prior to the actual start of construction and/or maintenance work or after all construction and/or maintenance work has been completed are exempt from these requirements. This section covers the work that is most commonly performed at the Laboratory. However, additional information on fall protection requirements can be found in 29 CFR 1926 Subpart M.

2. Definitions

a. **Anchorage** means a secure point of attachment for lifelines, lanyards, or deceleration devices.

b. **Body belt** (safety belt) means a strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device.

c. **Body harness** means straps which may be secured about the employee in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest and shoulders with means for attaching it to other components of a personal fall arrest system.

d. **Buckle** means any device for holding the body belt or body harness closed around the employee's body.

e. **Connector** means a device that is used to couple (connect) parts of the personal fall arrest system and positioning device systems together.

It may be an independent component of the system, such as a carabiner, or it may be an integral component of part of the system (such as a buckle or dee-ring sewn into a body belt or body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

f. **Controlled access zone (CAZ)** means an area in which certain work (e.g. overhand bricklaying) may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems and access to the zone is controlled.

g. **Dangerous equipment** means equipment (such as pickling or galvanizing tanks, degreasing units, machinery, electrical equipment, and other units) which, as a result of form or function, may be hazardous to employees who fall onto or into such equipment.

h. **Deceleration device** means any mechanism, such as a rope grab, rip-stitch lanyard, specially woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc. which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.

i. **Deceleration distance** means the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

j. **Equivalent** means alternative designs, materials, or methods to protect against a hazard which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials, or designs specified in the standard.

k. **Failure** means load refusal, breakage, or separation of component parts. Load refusal is the point where the ultimate strength is exceeded.

l. **Free fall** means the act of falling before a personal fall arrest system begins to apply force to arrest the fall.

m. **Free fall distance** means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

n. **Guardrail system** means a barrier erected to prevent employees from falling to lower levels.

o. **Hole** means a gap or void two inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface.

p. **Infeasible** means that it is impossible to perform the construction work using a conventional fall protection system (i.e. guardrail system, safety net system, or personal fall arrest system) or that it is technologically impossible to use any one of these systems to provide fall protection.

q. **Lanyard** means a flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

r. **Leading edge** means the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction.

s. **Lifeline** means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorage at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

t. **Low-slope roof** means a roof having a slope less than or equal to 4 in 12 (vertical to horizontal.

u. **Lower levels** refers to those areas or surfaces to which an employee can fall. Such areas or surfaces include, but are not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.

v. **Mechanical equipment** means all motor or human propelled- wheeled equipment used for roofing work, except wheelbarrows and mop-carts.

w. **Opening** means a gap or void 30 inches (76 cm) or more high and 18 inches (48 cm) or more wide, in a wall or partition, through which employees can fall to a lower level.

x. **Overhand bricklaying and related work** means the process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. Related work includes mason tending and electrical installation incorporated into the brick wall during the overhand bricklaying process.

y. **Personal fall arrest system** means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

z. **Positioning device system** means a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface such as a wall, and work with both hands free while leaning.

aa. **Qualified Person** means one who, by possession of a recognized degree, certificate, or professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems relating to the subject matter, the work, or the project.

bb. **Rope grab** means a deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

cc. **Roof** means the exterior surface on the top of a building. This does not include floors or formwork that, because a building has not been completed, temporarily become the top surface of a building.

dd. **Roofing work** means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck.

ee. **Safety-monitoring system** means a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.

ff. **Self-retracting lifeline/lanyard** means a deceleration device containing a drum-wound line that can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement and which, after onset of a fall, automatically locks the drum and arrests the fall.

gg. **Snap-hook** means a connector comprised of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. Snap-hooks are generally one of two types:

(1) The locking type with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection; or

(2) The non-locking type with a self-closing keeper which remains closed until pressed open for connection or disconnection. As of January 1, 1997, the use of a non-locking snap-hook as part of personal fall arrest systems and positioning device systems is prohibited.

hh. **Steep roof** means a roof having a slope greater than 4 in 12 (vertical to horizontal).

ii. **Toe-board** means a low protective barrier that will prevent the fall of materials and equipment to lower levels and provide protection from falls for personnel.

jj. **Unprotected sides and edges** means any side or edge (except at entrances to points of access) of a walking/working surface, e.g. floor, roof ramp, or runway where there is no wall or guardrail system at least 39 inches (1.0 m) high.

kk. **Walking/working surface** means any surface, whether horizontal or vertical, on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, form-work and concrete- reinforcing steel but not including ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.

ll. **Warning line system** means a barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and which designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.

mm. **Work area** means that portion of a walking/working surface where job duties are being performed.

3. Duty to Have Fall Protection

a. A Qualified Person shall determine if the walking/working surfaces on which its employees are to work have the strength and structural integrity to support employees safely. Employees shall be allowed to work on those surfaces only when the surfaces have the requisite strength and structural integrity.

b. Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is six feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.

c. Each employee who is constructing a leading edge six feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems.

Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the guidelines provided in Appendix E of 29 CFR 1926 Subpart M.

NOTE: There is a presumption that it is feasible and will not create a greater hazard to implement at least one of the above-listed fall protection systems. Accordingly, the employer has the burden of establishing that it is appropriate to implement a fall protection plan which complies with 29 CFR 1926 Subpart M for a particular workplace situation, in lieu of implementing any of those systems.

d. Each employee on a walking/working surface six feet (1.8 m) or more above a lower level where leading edges are under construction, but who is not engaged in the leading edge work, shall be protected from falling by a guardrail

system, safety net system, or personal fall arrest system. If a guardrail system is chosen to provide the fall protection, and a controlled access zone has already been established for leading edge work, the control line may be used in lieu of a guardrail along the edge that parallels the leading edge.

e. Each employee in a hoist area shall be protected from falling six feet (1.8 m) or more to lower levels by guardrail systems or personal fall arrest systems. If guardrail systems (or chain, gate, or guardrail) or portions thereof, are removed to facilitate the hoisting operation (e.g. during landing of materials), and an employee must lean through the access opening or out over the edge of the access opening (to receive or guide equipment and materials, for example), that employee shall be protected from fall hazards by a personal fall arrest system.

f. Each employee on walking/working surfaces shall be protected from falling through holes (including skylights) more than six feet (1.8 m) above lower levels, by personal fall arrest systems, covers, or guardrail systems erected around such holes.

g. Each employee on a walking/working surface shall be protected from tripping in or stepping into or through holes (including skylights) by covers.

h. Each employee on a walking/working surface shall be protected from objects falling through holes (including skylights) by covers.

i. Each employee on the face of form-work or reinforcing steel shall be protected from falling six feet (1.8 m) or more to lower levels by personal fall arrest systems, safety net systems, or positioning device systems.

j. Each employee on ramps, runways, and other walkways shall be protected from falling six feet (1.8 m) or more to lower levels by guardrail systems.

k. Each employee at the edge of an excavation six feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier.

l. Each employee at the edge of a well, pit, shaft, and similar excavation six feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, barricades, or covers.

m. Each employee less than six feet (1.8 m) above dangerous equipment shall be protected from falling into or onto the dangerous equipment by guardrail systems or by equipment guards.

n. Each employee six feet (1.8 m) or more above dangerous equipment shall be protected from fall hazards by guardrail systems, personal fall arrest systems, or safety net systems.

o. Each employee performing overhand bricklaying and related work six feet (1.8 m) or more above lower levels, shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems, or shall work in a controlled access zone.

p. Each employee reaching more than 10 inches (25 cm) below the level of the walking/working surface on which they are working shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system.

q. Each employee engaged in roofing activities on low-slope roofs, with unprotected sides and edges six feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems, or a combination of warning line system and guardrail system, warning line system and safety net system, or warning line system and personal fall arrest system, or warning line system and safety monitoring system. Or, on roofs 50 feet (15.25 m) or less in width, the use of a safety monitoring system alone (i.e. without the warning line system) is permitted.

r. Each employee on a steep roof with unprotected sides and edges six feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems with toe-boards, safety net systems, or personal fall arrest systems.

s. Each employee engaged in the erection of pre-cast concrete members (including, but not limited to, the erection of wall panels, columns, beams, and floor and roof "tees") and related operations such as grouting of pre-cast concrete members, who is six feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems, unless another provision provides for an alternative fall protection measure.

Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of 29 CFR 1926 Subpart M.

NOTE: There is a presumption that it is feasible and will not create a greater hazard to implement at least one of the above-listed fall protection systems. Accordingly, the employer has the burden of establishing that it is appropriate to implement a fall protection plan which complies with 29 CFR 1926 Subpart M for a particular workplace situation, in lieu of implementing any of those systems.

t. Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is six feet (1.8 m) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 m) above the walking/working surface, shall be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.

4. Protection from Falling Objects

When an employee is exposed to falling objects, the employer shall have each employee wear a hard hat and shall implement one of the following measures:

(1) Erect toe-boards, screens, or guardrail systems to prevent objects from falling from higher levels; or,

(2) Erect a canopy structure and keep potential fall objects far enough from the edge of the higher level so that those objects would not go over the edge if they were accidentally displaced; or,

(3) Barricade the area to which objects could fall, prohibit employees from entering the barricaded area, and keep objects that may fall far enough away from the edge of a higher level so that those objects would not go over the edge if they were accidentally displaced.

5. Fall Protection Systems Criteria and Practices

Fall protection systems shall comply with the applicable provisions of this section. Employers shall provide and install all fall protection systems required by this section before employees begin the work that necessitates the fall protection.

a. Guardrail systems and their use shall comply with the following provisions:

(1) Top edge height of top rails, or equivalent guardrail system members, shall be 42 inches (1.1 m) plus or minus 3 inches (8 cm) above the walking/working level. When conditions warrant, the height of the top edge may exceed the 45-inch height, provided the guardrail system meets all other criteria.

(2) Mid-rails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be installed between the top edge of the guardrail system and the walking/working surface when there is no wall or parapet wall at least 21 inches (53 cm) high.

(a) Mid-rails, when used, shall be installed at a height midway between the top edge of the guardrail system and the walking/working level.

(b) Screens and mesh, when used, shall extend from the top rail to the walking/working level and along the entire opening between top rail supports.

(c) Intermediate members (such as balusters), when used between posts, shall be not more than 19 inches (48 cm) apart.

(d) Other structural members (such as additional mid-rails and architectural panels) shall be installed such that there are no openings in the guardrail system that are more than 19 inches (.5 m) wide.

(3) Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds applied within two inches (5.1 cm) of the top edge, in any outward or downward direction, at any point along the top edge.

(4) When the 200-pound test load specified above is applied in a downward direction, the top edge of the guardrail shall not deflect to a height less than 39 inches (1.0 m) above the walking/working level.

(5) Mid-rails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 150 pounds applied in any downward or outward direction at any point along the mid-rail or other member.

(6) Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.

(7) The ends of all top-rails and mid-rails shall not overhang the terminal posts, except where such overhang does not constitute a projection hazard.

(8) Steel banding and plastic banding shall not be used as top rails or mid-rails.

(9) Top rails and mid-rails shall be at least one-quarter inch (0.6 cm) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than six-foot intervals with high-visibility material.

(10) When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section shall be placed across the access opening between guardrail sections when hoisting operations are not taking place.

(11) When guardrail systems are used at holes, they shall be erected on all unprotected sides or edges of the hole.

(12) When guardrail systems are used around holes used for the passage of materials, the hole shall have not more than two sides provided with removable guardrail sections to allow the passage of materials. When the hole is not in use, it shall be closed over with a cover, or a guardrail system shall be provided along all unprotected sides or edges.

(13) When guardrail systems are used around holes that are used as points of access (such as ladder-ways), they shall be provided with a gate, or be so offset that a person cannot walk directly into the hole.

(14) Guardrail systems used on ramps and runways shall be erected along each unprotected side or edge.

(15) Manila, plastic, or synthetic rope being used for top rails or mid-rails shall be inspected as frequently as necessary to ensure that it continues to meet the strength requirements.

b. Personal fall arrest systems and their use shall comply with the provisions set forth below. Effective January 1, 1997, body belts are not acceptable as part of a personal fall arrest system.

NOTE: The use of a body belt in a positioning device system is acceptable.

(1) Connectors shall be drop-forged, pressed or formed steel, or made of equivalent materials.

(2) Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.

(3) Dee-rings and snap-hooks shall have a minimum tensile strength of 5,000 pounds.

(4) Dee-rings and snap-hooks shall be proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or taking permanent deformation.

(5) Snap-hooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snap-hook by depression of the snap-hook keeper by the connected member, or shall be a locking type snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member. Effective January 1, 1997, only locking type snap-hooks shall be used.

(6) Unless the snap-hook is a locking type and designed for the following connections, snap-hooks shall not be engaged:

(a) directly to webbing, rope, or wire rope;

(b) to each other;

(c) to a dee-ring to which another snap-hook or other connector is attached;

(d) to a horizontal lifeline; or

(e) to any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself.

(7) On suspended scaffolds or similar work platforms with horizontal lifelines that may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

(8) Horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two.

(9) Lanyards and vertical lifelines shall have a minimum breaking strength of 5,000 pounds.

(10) Except as provided below, when vertical lifelines are used, each employee shall be attached to a separate lifeline.

(a) During the construction of elevator shafts, two employees may be attached to the same lifeline in the hoist-way, provided both employees are working atop a false car that is equipped with guardrails; the strength of the lifeline is 10,000 pounds (5,000 pounds per employee attached); and all other criteria specified for lifelines have been met.

(11) Lifelines shall be protected against being cut or abraded.

(12) Self-retracting lifelines and lanyards which automatically limit free fall distance to two feet (0.61 m) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.

(13) Self-retracting lifelines and lanyards which do not limit free fall distance to two feet (0.61 m) or less, rip-stitch lanyards, and tearing and de-forming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.

(14) Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses shall be made from synthetic fibers.

(15) Anchorage used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds per employee attached, or shall be designed, installed, and used as follows:

(a) as part of a complete personal fall arrest system which maintains a safety factor of at least two; and

(b) under the supervision of a qualified person.

(16) Personal fall arrest systems, when stopping fall, shall:

(a) limit maximum arresting force on an employee to 900 pounds when used with a body belt;

(b) limit maximum arresting force on an employee to 1,800 pounds when used with a body harness;

(c) be rigged such that an employee can neither free fall more than six feet (1.8 m), nor contact any lower level;

(d) bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 m); and

(e) have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of six feet (1.8 m), or the free fall distance permitted by the system, whichever is less.

NOTE: If the personal fall arrest system meets the criteria and protocols contained in Appendix C to subpart M of 29 CFR 1926, and if the system is being used by an employee having a combined person and tool weight of less than 310 pounds, the system will be considered to be in compliance with P.5.b.16 above. If the system is used by an employee having a combined tool and body weight of 310 pounds or more, then the employer must appropriately modify the criteria and protocols of the Appendix to provide proper protection for such heavier weights, or the system will not be deemed to be in compliance with P.5.b.16 above.

(17) The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.

(18) Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

(19) Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.

(20) The employer shall provide for prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves.

(21) Personal fall arrest systems shall be inspected prior to each use for wear, damage and other deterioration, and defective components shall be removed from service.

(22) Body belts shall be at least one and five-eighths (1-5/8) inches (4.1 cm) wide.

(23) Personal fall arrest systems shall not be attached to guardrail systems, nor shall they be attached to hoists except as specified elsewhere in this section.

(24) When a personal fall arrest system is used at hoist areas, it shall be rigged to allow the movement of the employee only as far as the edge of the walking/working surface.

c. Positioning device systems and their use shall conform to the following provisions:

(1) Positioning devices shall be rigged such that an employee cannot free fall more than two feet (.9 m).

(2) Positioning devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kN), whichever is greater.

(3) Connectors shall be drop-forged, pressed or formed steel, or made of equivalent materials.

(4) Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of this system.

(5) Connecting assemblies shall have a minimum tensile strength of 5,000 pounds (22.2 kN).

(6) Dee-rings and snap-hooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.

(7) Snap-hooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snap-hook by depression of the snap-hook keeper by the connected member, or shall be a locking type snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member. As of January 1, 1997, only locking type snap-hooks shall be used.

(8) Unless the snap-hook is a locking type and designed for the following connections, snap-hooks shall not be engaged:

(a) directly to webbing, rope or wire rope;

(b) to each other;

(c) to a dee-ring to which another snap-hook or other connector is attached;

(d) to a horizontal lifeline; or

(e) to any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself.

(9) Positioning device systems shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service.

(10) Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

d. Warning line systems and their use shall comply with the following provisions:

(1) The warning line shall be erected around all sides of the roof work area.

(a) When mechanical equipment is not being used, the warning line shall be erected not less than six feet (1.8 m) from the roof edge.

(b) When mechanical equipment is being used, the warning line shall be erected not less than six feet (1.8 m) from the roof edge which

is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 m) from the roof edge which is perpendicular to the direction of mechanical equipment operation.

(c) Points of access, materials handling areas, storage areas, and hoisting areas shall be connected to the work area by an access path formed by two warning lines.

(d) When the path to a point of access is not in use, a rope, wire, chain, or other barricade, equivalent in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area, or the path shall be offset such that a person cannot walk directly into the work area.

(2) Warning lines shall consist of ropes, wires, or chains, and supporting stanchions erected as follows:

(a) The rope, wire or chain shall be flagged at not more than six-foot (1.8 m) intervals with high-visibility material;

(b) The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches (.9 m) from the walking/working surface and its highest point is no more than 39 inches (1.0 m) from the walking/working surface;

(c) After being erected, with the rope, wire, or chain attached, stanchions shall be capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally against the stanchion, 30 inches (.8 m) above the walking/working surface, perpendicular to the warning line, and in the direction of the floor, roof, or platform edge;

(d) The rope, wire, or chain shall have a minimum tensile strength of 500 pounds, and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions as prescribed in the paragraph above; and

(e) The line shall be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

(3) No employee shall be allowed in the area between a roof edge and a warning line unless the employee is performing roofing work in that area.

(4) Mechanical equipment on roofs shall be used or stored only in areas where employees are protected by a warning line system, guardrail system, or personal fall arrest system.

e. Controlled access zones and their use shall conform to the following provisions.

(1) When used to control access to areas where leading edge and other operations are taking place, the controlled access zone shall be defined by a control line or by any other means that restricts access.

(a) When control lines are used, they shall be erected not less than six feet (1.8 m) nor more than 25 feet (7.7 m) from the unprotected or leading edge, except when erecting pre-cast concrete members.

(b) When erecting pre-cast concrete members, the control line shall be erected not less than six feet (1.8 m) nor more than 60 feet (18 m) or half the length of the member being erected, whichever is less, from the leading edge.

(c) The control line shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.

(d) The control line shall be connected on each side to a guardrail system or wall.

(2) When used to control access to areas where overhand bricklaying and related work are taking place:

(a) The controlled access zone shall be defined by a control line erected not less than 10 feet (3.1 m) or more than 15 feet (4.5 m) from the working edge.

(b) The control line shall extend for a distance sufficient for the controlled access zone to enclose all employees performing overhand bricklaying and related work at the working edge and shall be approximately parallel to the working edge.

(c) Additional control lines shall be erected at each end to enclose the controlled access zone.

(d) Only employees engaged in overhand bricklaying or related work shall be permitted in the controlled access zone.

(3) Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:

(a) Each line shall be flagged or otherwise clearly marked at not more than six-foot (1.8 m) intervals with high-visibility material.

(b) Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) [50 inches (1.3 m) when overhand bricklaying operations are being performed] from the walking/working surface.

(c) Each line shall have a minimum breaking strength of 200 pounds (.88 kN).

(4) On floors and roofs where guardrail systems are not in place prior to the beginning of overhand bricklaying operations, controlled access zones shall be enlarged, as necessary, to enclose all points of access, material handling areas, and storage areas.

(5) On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's work shall be removed.

f. Safety monitoring systems and their use shall comply with the following provisions:

(1) The employer shall designate a competent person to monitor the safety of other employees and the employer shall ensure that the safety monitor complies with the following requirements:

(a) The safety monitor shall be competent to recognize fall hazards;

(b) The safety monitor shall warn the employee when it appears that the employee is unaware of a fall hazard or is acting in an unsafe manner;

(c) The safety monitor shall be on the same walking/working surface with within visual sighting distance of the employee being monitored;

(d) The safety monitor shall be close enough to communicate orally with the employee; and

(e) The safety monitor shall not have other responsibilities that could take the monitor's attention from the monitoring function.

(2) Mechanical equipment shall not be used or stored in areas where safety-monitoring systems are being used to monitor employees engaged in roofing operations on low-slope roofs.

(3) No employee, other than an employee engaged in roofing work (on low-sloped roofs) or an employee covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.

(4) Each employee working in a controlled access zone shall be directed to comply promptly with fall hazard warnings from safety monitors.

g. Covers for holes in floors, roofs, and other walking/working surfaces shall meet the following requirements:

(1) Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover.

(2) All other covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

(3) All covers shall be secured when installed so as to prevent accidental displacement by the wind, equipment, or employees.

(4) All covers shall be color-coded or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.

NOTE: This provision does not apply to cast iron manhole covers or steel grates used on streets or roadways.

h. Falling object protection shall comply with the following provisions:

(1) Toe-boards, when used as falling object protection, shall be erected along the edge of the overhead walking/working surface for a distance sufficient to protect employees below.

(2) Toe-boards shall be capable of withstanding, without failure, a force of at least 50 pounds (222 N) applied in any downward or outward direction at any point along the toe-board.

(3) Toe-boards shall be a minimum of 3-1/2 inches (9 cm) in vertical height from their top edge to the level of the walking/working surface. They shall have not more than 1/4-inch (0.6 cm) clearance above the walking/working surface. They shall be solid or have openings not over one inch (2.5 cm) in greatest dimension.

(4) Where tools, equipment, or materials are piled higher than the top edge of a toe-board, paneling or screening shall be erected from the walking/working surface or toe-board to the top of a guardrail system's top-rail or mid-rail, for a distance sufficient to protect employees below.

(5) Guardrail systems, when used as falling object protection, shall have all openings small enough to prevent passage of potential falling objects.

(6) During the performance of overhand bricklaying and related work:

(a) No materials or equipment except masonry and mortar shall be stored within four feet (1.2 m) of the working edge.

(b) Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear from the work area by removal at regular intervals.

(7) During the performance of roofing work:

(a) Materials and equipment shall not be stored within six feet (1.8 m) of a roof edge unless guardrails are erected at the edge.

(b) Materials that are piled, grouped, or stacked near a roof edge shall be stable and self-supporting.

(8) Canopies, when used as falling object protection, shall be strong enough to prevent collapse and to prevent penetration by any objects which may fall onto the canopy.

i. A fall protection plan option is available only for employees engaged in leading edge work or pre-cast concrete erection work who can demonstrate that it is infeasible or it creates a greater hazard to use conventional fall protection equipment. The fall protection plan must conform to the following provisions.

(1) The fall protection plan shall be prepared by a qualified person and developed specifically for the site where the leading edge work or pre-cast concrete work is being performed and the plan must be maintained up-to-date.

(2) Any changes to the fall protection plan shall be approved by a qualified person.

(3) A copy of the fall protection plan with all approved changes shall be maintained at the job site.

(4) The implementation of the fall protection plan shall be under the supervision of a competent person.

(5) The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrail systems, personal fall arrest systems, or safety nets systems) are infeasible or why their use would create a greater hazard.

(6) The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection from the conventional fall protection systems. For example, the employer shall discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling.

(7) The fall protection plan shall identify each location where conventional fall protection methods cannot be used. These locations shall then be classified as controlled access zones.

(8) Where no other alternative measure has been implemented, the employer shall implement a safety monitoring system.

(9) The fall protection plan must include a statement that provides the name or other method of identification for each employee who is designated to work in controlled access zones. No other employees may enter controlled access zones.

(10) In the event an employee falls, or some other related, serious incident occurs (e.g. a near miss), the employer shall investigate the circumstances of the fall or other incident to determine if the fall protection plan needs to be changed (e.g. new practices, procedures, or training) and

shall implement those changes to prevent similar types of falls or incidents.

j. Safety net systems are another option available to protect employees from falls. Safety net systems, however, will seldom be used at Bettis-Pittsburgh. Should the need arise to use a safety net system, the requirements in 29 CFR 1926 Subpart M shall be utilized.

6. Training Requirements

The employer shall provide a training program for each employee who might be exposed to fall hazards. The program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards. "Supplemental Safety Plans" shall include employee and sub-tier employee training records to document compliance with 29 CFR 1926 Subpart M training requirements.

(1) The employer shall assure that each employee has been trained, as necessary, by a competent person qualified in the following areas:

(a) The nature of fall hazards in the work area;

(b) The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;

(c) The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection to be used;

(d) The role of each employee in the safety monitoring system when this system is used;

(e) The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;

(f) The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection;

(g) the role of employees in fall protection plans; and

(h) the requirements contained in this manual.

(2) The employer shall verify compliance by preparing a written certification record. The written certification record shall contain the name or other identity of the employee trained, the date(s) of the training, and the signature of the person who conducted the training or the signature of the employer. If the employer relies on training conducted by another employer or completed prior to the effective date of this section, the certification record shall indicate the date the employer determined the prior training was adequate rather than the date of actual training.

(3) The latest training certification shall be maintained.

(4) When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required, the employer should retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:

(a) Changes in the workplace render previous training obsolete; or

(b) Changes in the types of fall protection systems or equipment to be used render previous training obsolete; or

(c) Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.

7. Additional Guidance

Additional guidance for complying with the requirements to protect employees from falls can be found in the non-mandatory appendices of 29 CFR 1926 Subpart M. Copies of these appendices are available from Safety Engineering.

(1) These appendices contain the following information:

(a) Appendix A - determining roof widths to allow for use of a safety monitoring system;

(b) Appendix B - guidelines for guardrail systems;

(c) Appendix C - guidelines for personal fall arrest systems;

(d) Appendix D - guidelines for positioning device systems; and

(e) Appendix E - guidelines for fall protection plan.

Q. CRANES AND LIFTING EQUIPMENT

1. Any mobile crane brought on-site must have protection against two-blocking or supervisory controls must be provided to ensure the crane operator does not two-block the crane. In addition to the two-blocking protection, the crane operator is not permitted to render any safety devices inoperative (e.g. turn off or disconnect a limit switch). If supervisory controls are used in lieu of a two-block protective device, the person assigned those controls must be in constant contact with the crane operator at all times the crane is in operation. This person must not be assigned other duties during crane operation.

2. Only lifting and handling equipment that is identified with a rated capacity shall be used. Lifting and handling equipment shall not be loaded beyond its rated capacity except for load tests.

3. The Lifting and Handling Engineer shall be notified by the Bettis representative prior to the initial use of a mobile crane by a subcontractor at the Bettis Laboratory. The working area around a mobile crane shall be barricaded and appropriate signs posted such as: "Men Working Above" and "Hard Hat Area."

4. Standard crane signals shall be accepted by the crane operator only from the designated floor-man. In the event of an emergency, however, STOP signals shall be accepted from anyone. When more than one crane or hoist is being used on a single lift, the crane/hoist operators shall act together and take their signals from only one person.

5. Loads shall not be lifted or transported over people.

6. No one shall be permitted to ride on the load, the hook, or a sling.

7. Any accidents or any irregularities observed in the operation of lifting and handling equipment must be reported immediately to your supervisor. The supervisor is to promptly inform the Bettis representative. An accident is defined as any personnel injury or damage to equipment. If an accident involving any piece of lifting or handling equipment should occur, the equipment shall be secured and shall not be moved, operated, or in any way disturbed, except for rescue work or prevention of a subsequent cascade-type accident or emergency, until a thorough investigation has been conducted and a release is issued by the Manager of Safety Engineering. Safety Engineering will assist in the investigation.

8. If any doubt exists concerning the safety of any situation or condition, the operator shall not move the crane until the unsatisfactory condition is corrected and the supervisor of the operation and the Bettis representative have decided that the situation is safe.

9. Operators shall not eat, smoke, or read while actually engaged in the operation of a crane.

10. Operators shall examine their crane before the initial operation during a work shift for defective brakes, loose parts, or anything that could make the crane unsafe. When adjustments or repairs are found to be necessary, the conditions shall be reported to your supervisor and the Bettis representative is to be informed.

11. Crane controls shall be moved smoothly and gradually to avoid abrupt jerky movement of the load.

12. The operator shall not tie in, block, or in any other manner render any circuit breakers, limit switches, or other safety devices inoperative.

13. The operator shall test the overhead crane upper limit switch before making his first lift on a shift. The testing shall be done by raising the block until the limit switch opens the circuit. During such tests, care should be exercised to avoid striking the drum with the block if a limit switch fails to function.

14. Cranes shall not be operated when cables or chains show signs of defect or when limit switches are out of order. When such conditions are found, the crane shall be locked out and the supervisor shall be notified. The supervisor is to inform the Bettis representative of these deficiencies.

15. When leaving an overhead crane, the operator shall:

    a. Spot the crane in a remote area.
    b. Raise all hooks to a position near the upper limit switch.

c. Move all controls to the OFF position.
d. Set crane-disconnect switch in the OFF position.

16. The hook shall be placed directly over the load being lifted to avoid sliding the load and overstressing the hoisting equipment. Cranes shall not be used for side pulls except when specifically authorized by area management. Before authorizing the side pull, management must determine that the stability of the crane or hoist is not endangered and that the equipment will not be overstressed.

17. Before moving loads that are near the rated capacity, the brakes should be tested by moving the controller to the OFF position after the load is raised a few inches. If the hoist brakes do not hold, the load shall be lowered immediately and the brakes shall be adjusted or repaired before the crane is again used.

18. Loads shall not be left suspended in the air.

19. The operator shall not use limit switches to stop crane movements except for testing the switches.

20. Before lifting machinery or any other apparatus or material, the operator shall make sure that all bolts or other clamping devices have been removed.

21. In general, work shall not be performed on suspended loads. Exceptions may be granted only by management.

22. Mobile cranes, derricks, and similar equipment shall not be operated within 10 feet of overhead electric power lines unless the lines are de-energized and grounded at the point of work. Where lines cannot be de-energized, operations must be reviewed on a case basis by the cognizant Bettis representative. Travel clearance for mobile cranes is a minimum of four feet from energized lines.
23. Handling equipment shall be checked for defects before it is used and again when it is returned to storage. When in doubt about the safety of any equipment, consult the supervisor of the operations.

24. Slings shall be protected by the use of saddles, wood, rubber, or other padding at the sharp edges of a load.

25. Handling equipment not in use shall be removed from the crane hook or the load and stored properly.

26. When making choker hitches with slings having hooks, always face the hook opening out and away from the pull of the sling so the hook will not slip out when slack is taken out of the sling.

27. Loose pieces of material such as pipe, wood blocks, lifting gear, etc., shall be removed from the load before it is moved.

28. Only slings of proper length shall be used. No one shall twist or tie knots in a sling as a means of shortening it. Short slings shall not be tied together to make a longer sling nor be lengthened by passing one sling through the end fitting or eye of another sling or by suspending one sling from another. Only shackles shall be used to lengthen slings if required.

29. Cranes may be used as work platforms only when specifically approved for such work. The cognizant Bettis representative will furnish the Seller with the Area Crane Access Procedure.

R. EXCAVATIONS

1. Definitions

a. Benching System: A method of protecting personnel from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical walls between levels.

b. Cave-in: The separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench box or support system, and its sudden movement into the excavation in sufficient quantity to entrap, bury, or otherwise injure and immobilize a person.

c. Competent Person: One who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to personnel, and who possess authority to take prompt corrective measures to eliminate them.

d. Excavation: Any man-made cut, cavity, trench, or depression in any earth surface, formed by earth removal.

e. Hazardous Atmosphere: An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic or otherwise harmful may cause death, illness, or injury.

f. Protective System: A method of protecting personnel from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems may include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

g. Registered Professional Engineer: One who is registered as a professional engineer in the state where the work is to be performed.

h. Shield System: A structure that is able to withstand the forces imposed on it by a cave-in, thereby protecting employees within the structure. Shield systems designed for use in trenches are called trench boxes or trench shields.

i. Shoring System: A structure such as mechanical or timber shoring system that supports the sides of an excavation and is designed to prevent cave-ins.

j. Sloping System: A method of protecting personnel from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The required angle of incline will vary with soil type, environmental conditions of exposure, and application of surcharge loads.

k. Support System: A structure such as underpinning, bracing, or shoring that provides support to an adjacent structure, underground installation, or the sides of an excavation.

l. Tabulated Data: Tables and charts approved by a registered professional engineer and used to design and construct a protective system.

m. Trench (or trench excavation): A narrow excavation made below ground level which, after considering forms and other installed structures, has no unobstructed width greater than 15 feet.

2. General Rules

a. Excavations or trenches to depths of five feet or more require a Bettis-approved "supplemental safety plan." Blasting will be addressed on a case basis only.

b. All excavation work shall be supervised by an assigned competent person. Unless otherwise specified, all duties and responsibilities described below are those of the competent person assigned to the particular excavation work.

c. Competent persons must be constantly vigilant for evidence that could indicate possible cave-ins, failure of protective systems, hazardous atmospheres, or other hazardous conditions. Excavations, protective systems, and adjacent areas shall be inspected prior to starting each day's work and as needed throughout the day. Also, the competent person should perform an inspection after every rainstorm or other hazard-increasing occurrence when the competent person can reasonably anticipate worker exposure. Identified hazards shall be corrected before work is allowed to proceed.

d. All workers shall be instructed to immediately report to the competent person any evidence that could indicate possible cave-ins, failure of protective systems, hazardous atmospheres, or other hazardous conditions. In the competent person's absence, any worker with knowledge of hazardous conditions should clear the excavation of all personnel until the danger has been evaluated and abated.

e. Prior to beginning excavation work, the competent person shall determine the location of utility installations that reasonably may be encountered during the dig.

f. No worker shall be allowed beneath loads handled by lifting or digging equipment. Personnel must stand away from vehicles being loaded or unloaded. Vehicle operators may remain in the cab of a vehicle being loaded or unloaded only if the vehicle is equipped with a cab shield and/or canopy adequate to protect the operator from shifting or falling materials.

g. When backhoes are used as lifting equipment, safety rules for lifting equipment shall apply.

h. When personnel are required to be in trenches four feet deep or more, an adequate means of exit, such as a ladder or steps, shall be provided and located so as to require no more than 25 feet of lateral travel.

i. Excavations over four feet in depth could be considered Confined Spaces.

j. Additional guidance and requirements for excavations can be found in 29 CFR 1926, Safety and Health Regulations for Construction, Subpart P.

3. Barricades, Postings, and Illumination

a. All excavations shall be conspicuously barricaded or covered. The competent person shall ensure barricades are erected and maintained and proper postings are installed along all exposed sides of an excavation. Installed covers shall be capable of bearing at least two (2) times the maximum intended load (vehicle and pedestrian).

b. Sandbags or equivalent devices should always be installed to ensure barricade stability during periods of high winds.

c. Portable warning lights shall be installed to illuminate the barricade route at night.

d. Where an excavation interferes with established personnel egress routes, the competent person shall ensure barricades are installed and maintained along with portable warning lights, and postings as necessary to establish and illuminate a detour, and to direct personnel safely past the excavation site. When required, employees shall be protected from falls by a standard guardrail system.

e. Workers exposed to vehicular traffic shall wear warning vests or other suitable garment marked with or made of reflective or high visibility material.

f. All wells, pits, shafts, etc shall be barricaded or covered. Upon completion of exploration and similar operations, they shall be back-filled.

4. Protecting Workers from Hazards Associated with Water Accumulation

a. Excavation sites and adjacent areas shall be continually and effectively drained. The competent person shall ensure adequate de-watering equipment is available and properly operated to divert water flows away from the work area.

b. No one shall work in an excavation in which water has accumulated or is accumulating without adequate protection. Minimum protection shall include de-watering equipment with capacity sufficient to keep the excavation drained. Necessary protection may vary with each situation, but should include support or shield systems to protect against cave-ins and/or use of a safety harness and lifeline.

5. Protecting Workers and Structures from Hazards Accompanying Unstable Adjoining Structures

a. Where stability of a structure adjacent to an excavation is endangered, support systems (i.e. shoring, bracing, underpinning) shall be installed to stabilize the structure and protect exposed personnel.

b. Excavation below the level of the base or footing of any retaining wall or foundation that one reasonably expects to pose a hazard to employees shall not be permitted except when:

(1) a support system is installed;

(2) the excavation is in stable rock;

(3) a registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to remain unaffected by it; or

(4) a registered professional engineer has approved the determination that the excavation work poses no hazard to employees.

c. Sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or another method of protection is provided to protect workers from a possible collapse.

d. Objects such as sidewalks or street pavement shall not be used as arguments for soil stabilization. They shall be judged to worsen conditions since such features as fissures cannot be observed.

6. Protecting Workers from Loose Rock or Soil

a. Personnel shall be protected from loose rock or soil that could fall or roll from the excavation face by scaling to remove loose material, installing protective barriers at intervals sufficient to stop and control falling material, or other means that provide equivalent protection.

b. Personnel shall be protected from excavated or other materials or equipment that could fall or roll into the excavation by keeping all material and equipment at least two (2) feet from the edge of the excavation, installing adequate retention devices, or both when necessary.

7. Protective (Shoring and Sloping) Systems

a. Adequate protection against cave-ins is required in all excavations except when the excavation is made entirely within stable rock, or when the excavation is less than five feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

b. Protective systems shall have the capacity to resist without failure all loads intended (or reasonably expected) to be applied or transmitted to the system.

c. Manufacturers' and other tabulated data used to design sloping and shoring systems shall be maintained at the job site during constructions.

d. A manufacturer's specific written approval is required for any deviations from its specifications, limitations, and recommendations. This written approval must remain at the job site during construction.

e. Materials and equipment shall be free from defects or damage that might impair proper functioning, and shall be maintained consistent with the manufacturer's recommendations.

f. Damaged materials and equipment shall be evaluated by a competent person. If unsuitable for use, the suspect material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

g. Shoring and sloping systems shall be installed and removed in accordance with manufacturer's instructions.

h. No employees shall be allowed to work on the faces of sloped or benched excavations above other employees, except when employees below are adequately protected from falling materials and equipment.

i. Shoring, including manufactured shoring systems, shall extend eighteen (18) inches above the two-foot ledge at the top of the excavation.

j. Plywood shall not be used for shoring; it may be used only for sheeting.

k. Shoring for any excavation 20 feet or greater in depth shall be designed by a professional engineer.

8. Additional Requirements for Trench Boxes

a. Manufacturer's use and safety instructions, as well as tabulated data, shall be present at the job site.

b. Shield systems shall be installed so that lateral or other hazardous movements are restricted in the event sudden lateral loads are applied.

c. Personnel shall be protected from cave-in hazards when entering or exiting areas protected by the shield system.

d. Personnel shall not be allowed within a shield that is being installed, removed, or moved vertically.

e. Up to two feet of exposed earth material is permissible below the bottom of the trench box, but only if (1) the trench box is designed to resist the forces calculated for the full depth of the trench, and (2) there are not indications of a possible loss of soil from behind or below the bottom of the trench box.

9. Soil Classification

a. The bottom layer of soil determines the classification of the entire excavation.

b. At least one visual and one manual test must be performed at an excavation site prior to classifying the soil.

c. Free water in a trench renders the soil Class C.

d. Rain, mechanical disturbances, and other factors may change the soil classification at the work site.

e. Pavement or sidewalks do not enhance soil stabilization. Instead, they should be judged to worsen conditions, since conditions such as fissures cannot be observed.

10. Inspections

a. Cognizant supervisors and follow engineers should conduct frequent inspections of all excavations.

S. VEHICLES

1. Do not block exits, walkways, fire hydrants, or Fire Department sprinkler connections.

2. Do not exceed 15 mph on the Bettis Site property unless other speed limits are posted. This limit applies to all Bettis Site property (inside the fence and parking lot).

3. Personnel shall not ride on the outside of trucks.

4. Rollover protective structures shall be provided, whether for construction or maintenance services, on those vehicles covered by 29CFR 1926. Seat belts are required and must be worn when vehicles with rollover protection are operated.

5. When loads project beyond the rear of the truck, the end of the load shall be provided with a red flag by day and a red light at night.

6. Trucks shall be backed only under the direction of a signalman if the view to the rear of the truck is obstructed.

7. Before the dump truck bed is raised, the driver shall be sure there is overhead clearance.

8. Truck drivers should remain in the truck cab while the truck is being loaded or unloaded or a safe location shall be designated for the driver to wait.

9. Employees exposed to vehicular traffic shall be provided with and shall wear warning vests marked with or made of reflectorized or high visibility material.

10. All-terrain vehicles (ATVs) are not permitted to be brought onto the Bettis-Pittsburgh site without the permission of the Safety Engineering Manager.

11. Any vehicle with an obstructed view to the rear shall have a reverse signal alarm audible above the surrounding noise level or the vehicle shall be backed up under the direction of a signal person.

12. See 29CFR 1926, Subpart O for additional information and guidance on vehicle requirements.

T. SAFETY REQUIREMENTS FOR ENTERING AND WORKING IN CONFINED SPACES

1. Purpose and Scope

This section identifies the minimum requirements for personnel entry, work, and exit from confined spaces. Confined spaces can become unsafe as a result of: (1) atmospheric contamination by toxic or flammable vapors, or oxygen deficiency or excess; (2) physical hazards when heaters or moving parts are located therein; (3) liquids, steam, gases, or solids being admitted during occupancy; or (4) the rendering of the occupants isolated from help in case of need. Every effort to minimize potential dangers must be taken prior to entering and working in such areas. The requirements of this section apply to all Bettis and subcontractor operations involving personnel entry into confined spaces. These requirements are based on ANSI Standard Z117.1, "Safety Requirements for Confined Spaces" and 29CFR 1910.146, "Permit-Required Confined Spaces."

2. Definitions

a. Acceptable Entry Conditions - The conditions that must exist in a space to allow entry and to ensure that employees involved with a confined space entry can safely enter into and work within the space.

b. Attendant - A person who is assigned to stand by a confined space to monitor the process or operation and provide support or react to emergencies as required.

c. Authorized Entrant - Employee who is authorized by the supervisor and is trained to enter a confined space.

d. Biological Hazards - Infectious agents presenting a risk or potential risk to the well-being of man, or other animals, either directly through inhalation, ingestion, or skin absorption or indirectly through disruption of the environment.

e. Blinding/Blanking - Inserting a solid barrier across the open end of a pipe leading into or out of the confined space, and securing the barrier in such a way to prevent leakage of material into or out of the confined space.

f. Confined Space - An enclosed area that is large enough and so configured that an employee can bodily enter and has one or more of the following characteristics:

(1) its primary function is something other than human occupancy;

(2) it has restricted entry and exit; and

(3) it may contain potential or known hazards.

For further clarification concerning the classification of an enclosure as a confined space, contact Safety Engineering.

g. Double Block and Bleed - To isolate a confined space from a line, duct, or pipe by physically closing two in-line valves on a piping system and opening a "vented-to-atmosphere" valve between them.

h. Emergency - Any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the confined space that could endanger entrants.

i. Engulfment - The surrounding, capturing, or both, of a person by divided particulate matter or liquid that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

j. Entry - Ingress by persons into a confined space which occurs upon breaking the plane of the confined space portal with his/her face; and all periods of time in which the confined space is occupied.

k. Entry Permit - The document that allows and controls entry into a permit-required confined space.

l. Entry Supervisor - The person responsible for determining if acceptable entry conditions are present at a space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required. **NOTE:** An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

m. Hazard Evaluation - A process to assess the severity of known or potential hazards at or in the confined space.

n. Hazardous Atmosphere - An atmosphere that may be, or is injurious to occupants by reason of: oxygen deficiency or enrichment, flammability or explosivity; or toxicity. See Section 6 for acceptable limits.

o. Hot Work - Work within a confined space that produces arcs, sparks, flames, heat, or other sources of ignition.

p. Hot Work (Burning/Welding) Permit - Written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

q. Immediately Dangerous to Life or Health (IDLH) - Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a confined space. **NOTE:** Some materials - hydrogen fluoride gas and cadmium vapor, for example - may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

r. Inerting - The displacement of the atmosphere in a confined space by a non-combustible gas (such as nitrogen) to such an extent that the resulting atmosphere is non-combustible. **NOTE:** This procedure produces an IDLH oxygen-deficient atmosphere.

s. Isolation - The process by which a confined space is completely protected against the release of energy and material into the space by such means as: blanking or blinding; mis-aligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag-out of all sources of energy; or blocking or disconnecting all mechanical linkages.

t. LEL/LFL and UEL/UFL - Acronyms for "lower explosive limit"/"lower flammable limit" and "upper explosive limit"/"upper flammable limit." See the Bettis Industrial Hygiene Manual, Appendix A, for further guidance on explosive limits.

u. Line Breaking - The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

v. Lockout/Tag-out - The placement of a lock and tag on the energy-isolating device in accordance with an established procedure, indicating that the energy isolating device shall not be operated until removal of the lock and tag in accordance with an established procedure. See Section 4.11, Appendix B and Appendix D of this manual for further guidance.

w. Non-Permit Confined Space (NPCS) - A space which, by configuration, meets the definition of a confined space but which after evaluation is found to have little potential for generation of hazards or has the hazards eliminated by engineering controls. The space does not contain or have the potential to contain atmospheric hazards capable of causing death or serious physical harm.

x. Oxygen-Deficient Atmosphere - An atmosphere containing less than 19.5% oxygen by volume.

y. Oxygen-Enriched Atmosphere - An atmosphere containing more than 23.5% oxygen by volume.

z. PEL - An acronym for "Permissible Exposure Limit" which is the allowable air contaminant level established by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA).

aa. Permit Required Confined Space (PRCS) - A confined space that, after evaluation, has actual or potential hazards that have been determined to require written authorization for entry. The space has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

bb. PRCS Program - The employer's overall program for controlling and, where appropriate, for protecting employees from permit space hazards and for regulating employee entry into permit spaces.

cc. Permit System - The written permit that controls the PRCS entry and establishes controls prior to and during the occupation.

dd. Qualified Person - A person who, by reason of training, education and experience, is knowledgeable in the operation to be performed and is competent to judge the hazards involved. At Bettis, this will generally be the area supervisor or his or her designated alternate.

ee. Retrieval System - The equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from a confined space.

ff. Testing - The process by which the hazards that may confront entrants of a confined space are identified and evaluated. Testing includes specifying the tests that are to be performed in the confined space. **NOTE:** Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to and during entry.

gg. TLV - An acronym for "Threshold Limit Value" of a hazardous substance which is listed in the Industrial Hygiene Manual, Appendix B. The TLV's represent the Bettis airborne limit for time-weighted average exposure to hazardous substances.

hh. Toxic Atmosphere - An atmosphere containing a concentration of a substance above the published or otherwise known safe levels.

3. Identification and Evaluation

a. A confined space evaluation shall be conducted of the premises, or operations, or both to identify confined spaces as defined in this standard. The evaluation shall be conducted by a Qualified Person.

b. Hazards shall be identified for each confined space. The hazard identification process shall include, but not be limited to, a review of the following:

(1) the past and current uses of the confined space which may adversely affect the atmosphere of the confined space;

(2) the physical characteristics, configuration, and location of the confined space;

(3) existing or potential hazards in the confined space, such as:

(a) oxygen-deficient or enriched atmosphere,
(b) flammable or explosive atmosphere,
(c) toxic atmosphere, and
(d) hazardous energy systems;

(4) biological hazards, such as sanitary systems, associated with the confined space; and

(5) mechanical hazards.

c. Based on the evaluation of the hazards, Safety Engineering shall classify the confined space as either a permit-required confined space (PRCS) or non-permit confined space (NPCS).

d. If a PRCS no longer poses an actual or potential atmospheric hazard or all other hazards within the space are eliminated without entry into the space, the permit space may be reclassified as an NPCS for as long as the hazards remain eliminated.
(1) The evaluation shall document the basis for determining that all hazards in a PRCS have been eliminated. Safety Engineering shall complete and sign a new entry requirements form. The evaluation and entry requirements form shall be made available to each employee entering the space.

e. A Qualified Person or Safety Engineering shall determine the need for periodic re-evaluation of the hazards based on possible changes in activities in the space, or other physical or environmental conditions, or both, which could adversely affect the space. When the need is determined, a Qualified Person shall conduct the re-evaluation process.

4. Non-Permit Confined Space (NPCS)

a. Safety Engineering shall issue confined space entry requirements for each evaluated confined space and address specific measures and precautions which must be taken to safely enter an NPCS.

b. The entry requirements shall specify what conditions and precautions must be in place to allow for safe entry and what would constitute a change in conditions which would require a re-evaluation of the confined space.

c. NPCS's shall be periodically re-evaluated to assure proper classification. Safety Engineering will request supervisors to review their confined space evaluations every two years and report any changes.

d. Any known change of conditions in the space, which introduces new hazards to the space, shall require an immediate re-evaluation.

e. Atmospheric testing, by a trained monitor, shall be conducted as identified on the entry requirements form issued by Safety Engineering. See Section T.21 for training requirements. If atmospheric test results are not within acceptable limits, the engineering controls are not adequate, or the potential for generation of hazards is not as minimal as was initially determined, the confined space is no longer an NPCS.

5. Permit Required Confined Space (PRCS)

a. A permit shall be established for all PRCS entries. The intent of the permit system is to provide a systematic review for hazards, communicate this information, and provide an approval sign-off for entries. The permit shall include:

(1) the date of entry, the location of the space, and operations which will be conducted in the confined space;

(2) the hazards to be controlled or eliminated prior to proceeding with the entry;

(3) safety equipment required to perform the entry;

(4) job duties in the confined space;

(5) safety precautions required to perform the job;

(6) the type of atmospheric tests required and the results of those tests;

(7) the type of equipment which will be necessary for a rescue and how aid will be summoned in the event of an emergency; and

(8) the supervisor verifies that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.

b. Before each entry into a PRCS, the completed permit will be reviewed with the workers and posted outside the space.

c. Only operations or work originally approved on the permit shall be conducted.

d. When conditions or work activity are different than those specified on the permit, the permit shall be immediately revoked. A new permit to cover the conditions or work activity shall be issued to address these changes and new hazards. For example, if it is determined that welding needs to be conducted, a new permit shall be issued that addresses the need for hot work and a welding permit. A new evaluation will be required to address the hazard and precautions needed. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

e. Entry permits (see Appendix 3) shall be issued a number by the area supervisor and shall be retained by the activity for a period of two years. A copy of each permit shall also be forwarded to Safety Engineering.

f. Entry permits retained per item e. above shall be reviewed by area management and Safety and the program shall be revised as necessary to ensure that employees participating in entry operations are protected from permit space hazards.

6. Atmospheric Testing Requirements

a. Before entry into a confined space, testing shall be conducted for hazardous atmospheres by a trained monitor. Testing equipment used in confined spaces shall be listed or approved for use in such areas. This listing or approval shall be from nationally recognized testing laboratories such as Underwriters Laboratories or Factory Mutual Systems.
Testing will generally consist of oxygen and combustible gas indicators. For vertical entries, remote probes are required to measure results at various levels of the confined space. If there is no potential for a flammable atmosphere, the flammability testing may be waived. Review the confined space entry requirements for the space being entered. Functional checks shall be performed on the equipment before use using manufacturer's recommended methods. Periodically, equipment with internal calibration devices shall be calibrated and maintained per manufacturer's instructions. This internal calibration is performed by Safety Engineering.

Toxicity tests will normally be conducted using calorimetric sample tubes, organic vapor analyzers, photo ionization detectors, or other instant read-out equipment. Although more accurate methods may exist, the practicality of the testing must be considered. Testing sequence should be oxygen, flammability, and then toxicity. Toxicity tests will be conducted by Safety Engineering, persons trained by Safety Engineering, or persons approved by Safety Engineering.

b. Entry into some confined spaces may require radon measurements. See WAPD-RC-500 for applicable requirements or contact RC&E-Radiological Monitoring and Safety.

c. Initial testing of atmospheric conditions and subsequent tests after a job has been stopped for a significant period of time shall be done with the ventilation systems shut down. A significant period would be a lunch break or similar situation.

d. Further testing shall be conducted with ventilation systems turned on to ensure that the contaminants are removed and that the ventilation system is not itself causing a hazardous condition. Testing with the ventilation on can reveal problems, such as the suction of engine exhaust gases into the confined space or situations where pneumatically powered blowers or tools bring contaminated air or other gases into the confined space.

e. If the confined space is vacated for any significant period of time (see c. above), the atmosphere of the confined space shall be re-tested before re-entry is permitted.

f. Atmospheric testing may be waived for NPCS’s only if such spaces are properly ventilated before and during occupancy and it has been established through a formal hazard identification and evaluation study that the ventilation is sufficient to guard against atmospheric contamination. Review the confined space entry requirements for the space being entered.

g. Testing of confined spaces shall be conducted throughout the entire portion of the space to be occupied. Confined spaces which are deep, have odd shapes,

or remote areas may require that a probe or extension be added to the sampling equipment or occupants may be required to take sampling equipment into the confined space for testing purposes. This sampling shall be done progressively so that personnel are aware of any deteriorating conditions as they move to remote areas of the confined spaces. If this sampling indicates any deteriorating conditions, the atmospheric monitor shall immediately stop and exit the area.

h. If a hazardous atmosphere is detected during entry:

(1) Each employee shall leave the space immediately;

(2) The space shall be evaluated to determine how the hazardous atmosphere developed; and

(3) Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

7. Acceptable Limits

a. The atmosphere of the confined spaces shall be considered within acceptable limits whenever the following conditions are maintained:

(1) Oxygen - 19.5% to 23.5%;

(2) Flammability - less than 10% of the Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL);

(3) Toxicity - less than recognized exposure limits; and

(4) Any other atmospheric condition that is immediately dangerous to life or health is adequately controlled or eliminated.

b. Whenever testing of the atmosphere indicates that levels of oxygen, flammability, or toxicity are not within acceptable limits, entry shall be prohibited until appropriate controls are implemented or appropriate personal protective equipment (PPE) is provided.

c. If the source of the contaminant cannot be determined, precautions shall be adequate to deal with the worst possible condition that the contaminant could present in the confined space.

d. If there is the possibility that the confined space atmosphere can become unacceptable while the work is in progress, procedures and equipment shall be provided to allow the employee to safely exit the confined space.

8. Attendant

a. While employees are inside any confined space, another trained employee or employees within voice or visual range shall be available in the immediate vicinity to summon emergency assistance as may be required. Emergency rescue equipment, if required, shall be readily available. The duties of the attendant include:

(1) provide standby assistance to workers entering the space;

(2) direct workers to exit the confined space when any irregularities are observed;

(3) initiate evacuation and emergency procedures;

(4) monitor for any conditions that could adversely affect the workers;

(5) remain at the entry point unless relieved by another attendant; and

(6) control unauthorized entry.

b. "Standby Assistance" may include checking breathing air cylinders, or any ancillary duties that do not require the attendant to enter the confined space or leave his position.

c. The number of attendants needed shall be determined by a Qualified Person. The number of attendants should be determined by considering the manpower it will take to carry out duties assigned to the attendant for the entry(ies). If several entry points are within a few feet of each other, one attendant may be able to monitor more than one entrance. This would be dependent upon the attendant's ability to stay in contact with the entrants and summon aid in the event of an emergency.

d. Communication methods should be selected according to hazards and potential for injury or harm to personnel entering the space. Signaling, visual contact, and radio communication are examples of available methods.

9. Entrant

a. The entrant(s) shall know the potential hazards that may be encountered during the entry and be aware of the proper use and limitations of equipment used to control hazards.

b. Know how to respond to emergencies including methods for self-rescue.

c. Know symptoms and warning signs of exposure to potential hazards or prohibited conditions.

d. Notify the attendant of any emergency or unacceptable condition in the confined space.

e. Exit the confined space immediately if symptoms, warning signs, or unacceptable conditions occur or if directed by the attendant or entry supervisor.

f. Remain in constant two-way communication with the attendant.

10. Entry Supervisor

a. Know the requirements of the confined space entry program, including proper execution of duties of entrants, attendants, and rescue personnel.

b. Verify that all required actions are taken prior to endorsing the permit and allowing entry to begin, and ensure that acceptable conditions are maintained for the duration of the entry.

c. Verify that rescue services are available, if required, and that the means for summoning them are operable.

d. Terminate entry, assure removal of personnel and equipment, and cancel the permit when required.

11. Isolation and Lockout/Tag-out

a. All energy sources which are potentially hazardous to confined space entrants shall be secured, relieved, disconnected, and/or restrained before personnel are permitted to enter the confined space. The objective is the control of any situation where unexpected energization, start-up, or release of stored energy would cause injury to workers. Energy sources may include: electrical, mechanical, hydraulic, pneumatic (air), chemical, thermal, radioactive, and the effects of gravity.

b. Isolation methods shall be selected and used to prevent flammable, toxic, irritating, or oxygen-displacing gases and vapors from entering the space. All hazardous material, high pressure, high temperature, and other piping that could introduce a hazard shall be isolated by utilizing blinding, disconnection, removal, or double block and bleed as needed to prevent entry of material(s) and hazardous contaminant(s).

Before the method(s) of isolation is selected, a Qualified Person shall consider the hazards that may exist or develop which includes temperature, pressure, flammability, reactivity, corrosiveness, or toxicity of material in the piping and reactions that could occur with cleaning or purging agents, as well as any physical hazards.

A confined space shall be isolated to prevent entry of material(s) and hazardous contaminants using one or more of the following methods:

(1) inserting a blank, sized for the proper pressure, in piping nearest to the confined space;

(2) depressurizing and disconnecting contaminant supply line(s) and providing a blank or blind on piping leading into the confined space;

(3) misaligning pipe(s) at connections closest to the confined space and cap, blind, or plug the ends; and

(4) utilizing two (2) blocking valves with an open vent or bleed valve

(5) between the blocking valves. If the bleed valve is not the same diameter as the line, then the bleed point should be monitored periodically during the work shift.

c. Pipelines or similar conveyances between the confined space and point(s) of isolation shall be drained, cleaned, or flushed of hazardous material and known hazardous contaminants as necessary.

d. Pipelines between the confined space and the first valve, blank, or associated equipment may contain material or hazardous contaminants. A Qualified Person should ensure that such piping has been flushed, cleaned, or purged. If this is not possible, i.e., a clogged line, special precautions and procedures necessary to protect workers and control the hazards shall be in place.

d. Precautions shall be taken to ensure that whenever drains, vents, or piping are left open that reversal of flows, or air contamination from adjacent processing, or chemical handling, cannot enter the confined space.

e. Special precautions shall be taken when entering double-walled, jacketed, or internally insulated confined spaces that may discharge hazardous material through the vessel's internal wall.

Distillation vessels, boilers, and similar type equipment may contain cracks or leaks that may produce a hazardous environment inside the confined space.

f. Lockout and tag-out shall be in accordance with 29CFR 1910.147, "The Control of Hazardous Energy," contained in Appendices 5 and 6.

12. Ventilation

a. When ventilation is used to remove atmospheric contaminants from the confined space, the space shall be ventilated until the atmosphere is within the acceptable ranges. Consideration should be given to the volume of the space to be ventilated, the output capacity of the ventilating device, and the distribution of air within the confined space. Ventilation normally consists of a pre-entry purge of several air changes, then continuous introduction of fresh air during occupancy. Natural ventilation may be acceptable if it can achieve the same results as the mechanical ventilation. Consideration shall be given to bonding or using intrinsically safe air movers when moving flammable atmospheres.

b. Blowers or other means of introducing air into the space shall be placed in such a manner to minimize the possibility of introducing air contaminants that may create unacceptable limits (e.g. carbon monoxide).

c. Prior to entry and during occupation, the confined space shall be ventilated as required with safe respirable air to prevent the accumulation of:

(1) flammables in the atmosphere above 10% of the LEL;

(2) concentrations of combustible dust;

(3) toxic or other contaminants in the atmosphere above one-half of the TLV or PEL;

(4) toxic or other hazardous substances having no rated TLV;

(5) oxygen-deficient or excess atmospheres; and

(6) asphyxiants such as argon, freon, nitrogen, etc.

A Qualified Person shall ensure that air from the confined space is exhausted to a location where it presents no hazard to employees or equipment.

When flammable contaminants are to be purged, precautions shall be taken to eliminate sources of ignition. These may include:

(1) posting or barricading the area to prevent unauthorized entry of persons or vehicles;

(2) prohibiting welding, burning, or other work in the area that could be a source of ignition; and

(3) prohibiting smoking and the carrying of matches or other sources of ignition into the potentially hazardous area.

d. Occasionally, the conditions under which work must be done may require entry into a confined space subject to an oxygen-deficient or toxic atmosphere. Persons authorized by the area supervisor and working to an approved procedure may be permitted to enter without complete ventilation of the space provided the following steps are followed:

(1) A self-contained breathing apparatus (positive pressure mode) or supplied-air respirator shall be worn when entering and working in the confined space (filter-type respirators are of no value in an oxygen-deficient or a highly toxic gas atmosphere).

(2) The worker shall be trained and qualified in the use of self-contained or supplied-air respirator.

(3) Safety harnesses and lanyards shall be used. Fall-arresting systems shall be worn by entrants as determined by the Qualified Person.

(4) A person, also provided with appropriate personal protective equipment, shall be stationed outside the confined space, holding the lanyard while observing and maintaining communication with the entrants. This person is <u>in addition</u> to the attendant.

13. <u>Cleaning and Decontamination</u>

a. Confined spaces shall be cleaned or decontaminated of hazardous materials to the extent feasible before entry. In some instances, the purpose of the entry is to clean the confined space. In these cases, the confined space should be cleaned or decontaminated as much as possible before personnel enter. Proper personal protective equipment and other precautions should be used to address any hazards that will remain after the pre-entry cleaning.

b. Cleaning or decontamination shall be the preferred method of reducing exposure to hazardous materials. Where this is not practical, personal protective equipment shall be worn by the entry personnel to provide appropriate protection against the hazards that may be present. Prior to commencing cleaning or decontamination operations, care should be exercised in the selection of cleaning compounds to ensure their compatibility with the environment in which they will be used.

14. Personal Protective Equipment (PPE)

a. A Qualified Person shall determine personal protective equipment needed by all personnel entering the confined space, including rescue teams. PPE shall be inspected prior to each use.

15. Safeguards

a. Each entry and exit point shall be evaluated to determine the most effective methods and equipment to be utilized to enable employees to safely enter and exit the confined space. Safe entry and exit means shall be provided for confined spaces. Fall-arresting systems shall be worn by personnel entering vertical confined spaces and personnel exposed to falling into the space as determined by a qualified person.

b. Appropriate retrieval equipment or methods to facilitate non-entry rescue shall be used whenever a person enters a PRCS. Exception: If the retrieval equipment increases the overall risks of entry or does not contribute to the rescue, its use may be waived. The type of retrieval equipment required is dependent on the specific circumstances. Consideration should be given to the size and location of the opening to the space, obstacles within the space, number of entrants, type of retrieval equipment, and whether or not the rescue would be vertical or horizontal.

Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of the chest or full body harness if it can be demonstrated that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the PRCS in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type PRCS more than five feet deep.

c. Where a potential exists for persons or objects to fall into a confined space, warning systems or barricades shall be employed at the entrance.

d. Where there is a potential for electrical shock, appropriate electrical equipment or systems shall be used. This would include protection such as ground fault circuit interrupters, double insulated tools, and low-voltage systems.

e. The Qualified Person shall have read the evaluation for the particular space being entered. This written evaluation shall be performed and documented by the area manager. A copy of this evaluation shall be maintained by the area supervisor. Safety Engineering also keeps a copy on file.

f. The Qualified Person shall have ensured that all requirements listed on the written evaluation for a particular confined space have been met.

In addition, the Qualified Person shall assure that action is taken to:

(1) depressurize the confined space;

(2) isolate the confined space; and

(3) ensure lockouts and tag-outs are complete per Section 3.18.9 of this manual.

g. A Qualified Person shall evaluate conditions that might be inside a closed space prior to removing the entrance cover. This can be accomplished, for example, by sampling remotely through the small hole in manhole covers. Any unsafe condition shall be eliminated prior to removing the cover.

(1) When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

h. If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the work site, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

16. Posting of Signs

a. Confined spaces that have readily accessible entryways shall be posted to indicate the precautions to be taken. This determination is made and documented by Safety Engineering. The precautions may include monitoring for oxygen, combustible or toxic gases, ventilation, safety harness and lanyard, attendant, entry permit, or any combination of these and other precautions deemed necessary. Spaces not requiring special precautions need not be posted. Obvious confined spaces such as vessels, tanks, and manholes need not be posted.

b. Signs shall be maintained in a legible condition.

c. For PRCS's that must be posted, the sign shall contain a warning that a permit is required before entry and have the words "DANGER" and "DO NOT ENTER."

d. PRCS's that are not required to be posted must be isolated to prevent easy entry. The supervisor shall review the hazards of these spaces and the requirement for reevaluation and/or permits with affected employees.

17. Hot or Spark-Producing Work

a. Hot work, i.e., burning, welding or open-flame soldering, is not permitted in a confined space until a Burning/Welding Permit has been issued per Section K.1 of this manual. In addition, the following requirements apply to hot work or spark-producing work such as grinding if the confined space has contained a flammable or combustible liquid, vapor, or gas. A Qualified Person shall ensure by inspection and test that:

(1) the concentration of flammable vapors or gases in the atmosphere is below 10% of the LEL;

(2) the liquid and solid residues have been removed as necessary to prevent the release of flammable vapors or gases that will raise the concentration above 10% of the LEL; and

(3) all inactive piping within the confined space has been purged to reduce the concentration of flammable vapor or gas to less than 10% of the LEL.

b. When hot work is to be performed on a tank shell or conductive boundaries of other confined spaces, the same precautions shall be exercised inside and outside the space where the hot work is being performed.

c. All gas or oxygen cylinders and manifolds shall be located outside the confined space. Small propane torches may be used inside a space only if continuous monitoring is performed.

d. Before hot work is started on a surface covered with a preservative or protective coating, the flammability and thermal decomposition products of the coating shall be considered. Where coatings are flammable, they shall be stripped from the area of hot work to prevent ignition.

e. In confined spaces, all surfaces covered with coatings that would decompose under hot work into toxic, corrosive, or irritant components shall be stripped from the area of heat application for a distance of at least six inches. Otherwise, employees shall wear respirators in accordance with a "supplemental safety plan."

18. Use of Hazardous Materials

a. Removal of paints and coatings, including organic coatings, adhesives, and resins with highly toxic or flammable solvents, in a confined space requires a procedure, approved by Safety Engineering and Environmental Engineering.

b. Application of paints, epoxies, preservatives, linings, etc., requires a procedure, approved by Safety Engineering and Environmental Engineering.

c. The procedure shall address the following precautions to protect the health of employees as applicable:

(1) The operation shall be enclosed to prevent the escape of vapor into the working space.

(2) Mechanical exhaust ventilation shall be provided to remove vapors at the source, and the concentration of the contaminants in the worker's space shall be maintained below the TLV or PEL.

(3) Where neither the requirements of (1) or (2) above can be achieved, employees shall wear appropriate personal protective equipment, i.e., respirators, gloves, etc.

(4) When materials used are capable of producing a flammable atmosphere under the conditions of use, smoking, open flames, arcs, and spark-producing equipment shall be prohibited in the area during their use and until atmospheric monitoring has confirmed that the vapor concentration is below 10% of the LEL.

(5) Rags and other materials dampened with solvents shall be placed in a covered container outside the confined space.

(6) Appropriate fire extinguishing equipment shall be available as near as practical to the work area. CO_2 fire extinguishing equipment shall not be used in a confined space.

(7) If confined space work is being performed on weekends, holidays, second or third shift, a two-way radio or telephone shall be established at the job site to provide for immediate help if needed.

19. Friable Asbestos Inspection

a. Upon entry into a confined space, but prior to commencing any work, the work area shall be visually inspected for unidentified or known asbestos insulation that is loose or deteriorated.

b. If unidentified or known asbestos insulation is found to be loose or deteriorated, STOP, exit the area, and post the entrances "Asbestos Controls Required For Entry."

c. Samples should be collected for unidentified insulation per the procedure for bulk field samples to be analyzed for asbestos content, found in Appendix C of the Industrial Hygiene Manual.

d. If time restraints prohibit collection and/or analysis of bulk samples, the insulation must be assumed to be asbestos. In this case, an Asbestos Work Permit will be required. Also, the work must be performed by asbestos workers. For more details on training and controls for asbestos work, see Chapter Three and Appendix C of the Bettis Industrial Hygiene Manual.

20. Medical Suitability

The physical and psychological suitability of persons to do confined space work shall be considered prior to working in confined spaces.

Since confined space entry work may require the use of respiratory protection, possible exposure to various physical stresses such as thermal, humidity, noise, vibration, etc., and psychological stresses such as claustrophobia, and vertigo; these

concerns need to be addressed by a physician or other licensed medical practitioner. Physical qualifications for respirator use are contained in ANSI Z88.6. The physical and psychological capabilities of potential candidates for confined space work can be evaluated during training exercises for the confined space work.

21. Subcontractors

a. Subcontractors who will enter confined spaces shall have a "supplemental safety plan" approved by Safety Engineering.

b. The safety plan will be reviewed by the subcontractor safety representative, the follow engineer, and a member of the Bettis Safety Engineering staff.

(1) The subcontractor shall be informed of known potential hazards associated with the confined space to be entered.

(2) For PRCS's, the subcontractor shall also provide a written emergency response plan.

(3) The Bettis follow engineer shall coordinate entry operations with the subcontractor, when both Bettis personnel and subcontractor personnel will be working in or near the same confined spaces.

(4) The Bettis follow engineer shall coordinate and control entry operations when employees of more than one subcontractor need to work simultaneously in a confined space so that employees of one subcontractor do not endanger the employees of any other subcontractor.

(5) The subcontractor shall notify the Bettis follow engineer of any hazards confronted or created during confined space entry operations.

22. Emergency Response

a. A procedure approved by Safety Engineering (attached to the entry permit) is required which describes the rescue provisions for the workers should an emergency arise in a PRCS. It shall include the method of rescue, designation of rescue personnel, the type and availability of equipment needed for rescue, and the means to summon rescuers in a timely manner. Emergency response personnel shall simulate actual rescue conditions by conducting practice drills. These drills should be timed. Rescuers should be able to effectively locate the emergency site without delays.

The procedure should address the following:

(1) what steps and equipment will be required to get personnel out;

(2) how to ensure emergency medical treatment will begin within four minutes for a person with cardiopulmonary arrest;

(3) what mechanical lifting devices (for vertical entries) will be required; and

(4) what means will be employed to summon aid and rescue personnel.

b. If PRCS entry is to be made on back-shift or weekends, the procedure for emergency response shall also have the concurrence of Medical and Security.

c. All rescue personnel must use self-contained breathing apparatus (SCBA) or Combination Type C Airline/SCBA breathing equipment when entering the confined space to rescue victims in a hazardous atmosphere.

In some instances, the entrance to the confined space may be such that an SCBA unit on the rescuer will not fit through the opening of the confined space. This shall be pre-determined in hazard identification and evaluation or drills. In this event, the rescuer may be required to use Combination Type C Airline/SCBA type breathing equipment.

d. If it is established that the cause of the emergency is not a hazardous atmosphere, rescue-breathing equipment is not required.

e. For an NPCS, the attendant shall receive instructions from his supervisor on how to summon aid and rescue personnel. A written procedure is not required for rescue operations for an NPCS.

23. Training

a. General confined space safety training for personnel responsible for supervising, planning, entering, or participating in confined space entry shall be provided prior to being assigned confined space duties and once every two years thereafter by the subcontractor. Training shall include:

(1) an explanation of the general hazards associated with confined spaces;

(2) an explanation of the permit system and other procedural requirements for conducting a confined space entry;

(3) how to respond to emergencies;

(4) duties and responsibilities as a member of the confined space entry team;

(5) a description of how to recognize probable air contaminant overexposure symptoms to personnel, and method(s) for alerting attendants;

(6) a review of the types of physical and psychological stresses which may be encountered when performing confined space work;

(7) how to communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space, if necessary; and

(8) exiting the space whenever ordered to do so by the attendant or when a warning sign or symptom of exposure is recognized.

b. Specific confined space training on the hazards that will be encountered for each particular confined space entry will be provided, prior to entry, by the

subcontractor supervisor or a Qualified Person designated by the supervisor. Training shall include:

(1) review of the confined space evaluation form with the workers;

(2) review of the confined space entry requirements;

(3) a discussion of specific confined space hazards associated with the facility, location, or operation;

(4) the reason for, proper use, and limitations of personal protective equipment and other safety equipment required for entry into confined spaces;

(5) review of the confined space entry permit (if required);

(6) review of the emergency response procedure (if required);

(7) a review to ensure that personnel have received general safety training from Safety Engineering within the past two years; and

(8) a determination as to whether the personnel entering the confined space have any psychological stresses such as claustrophobia and vertigo. The supervisor or Qualified Person designated by the supervisor shall refer any psychological stress concerns to Medical prior to entry;

(9) review of past deviations from entry requirements and any known inadequacies in knowledge of confined space rules and procedures;

(10) verifies that rescue services are available and that the means for summoning them are operable for PRCS; and

(11) removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

c. Training for attendants shall be conducted by the subcontractor supervisor. Training shall include:

(1) duties, responsibilities, and procedures for both routine and emergency operations;

(2) the hazards that may be encountered by entrants;

(3) the procedure for summoning rescue or other emergency services;

(4) the proper use of equipment used for communicating with entry and emergency/rescue personnel;

(5) reminding the attendant that he or she should never enter the confined space to attempt a rescue unless relieved by another attendant;

(6) knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(7) is aware of possible behavioral effects from hazard exposure;

(8) maintains an accurate count of authorized entrants;

(9) communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under adverse conditions;

(10) monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the space immediately under adverse conditions;

(11) summons rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape;

(12) warns unauthorized persons to stay away from confined spaces and notifies authorized entrants and the entry supervisor if unauthorized persons have entered the confined space;

(13) performs non-entry rescues if feasible; and

(14) performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

d. Training for atmospheric monitoring personnel shall include training in the proper use of atmospheric monitoring instruments. This shall include field calibration, basic knowledge of the work being performed, the anticipated hazardous contaminants, and any process that could significantly alter original conditions inside or outside the confined space. This training will be conducted or provided and documented by the subcontractor once every two years.

It is important for individuals conducting atmospheric tests to possess adequate knowledge of the proper operation of monitoring equipment as well as its limitations associated with anticipated conditions (such as inaccurate measurement readings for flammable gas when the oxygen level is below 16% for certain equipment). Similarly, these individuals should have information about the related process to anticipate potential atmospheric contaminants, such as a nearby vessel containing a highly toxic substance that could endanger the entry team in the event of a leak or release.

e. Training for emergency response personnel for PRCS entries shall be overseen by the cognizant supervisor or Qualified Person designated by the supervisor. Training shall include:

(1) use of a typical emergency response procedure;

(2) simulation of actual rescue conditions by conducting practice drills, including timing of rescuers to determine if adequate time was allotted for successful cardiopulmonary resuscitation (CPR) and first-aid techniques;

(3) first-aid and CPR techniques;

(4) use of emergency rescue equipment and personal protective equipment; and

(5) ability of rescuers to effectively locate the emergency site without undue delay.

Each member of the response team shall be trained in basic first aid and in cardiopulmonary resuscitation (CPR). At least one member of the response team holding current certification in first aid and CPR shall be available.

Emergency response training shall be conducted prior to initial entry into a PRCS and at least once every 12 months thereafter if the space remains active. Safety Engineering shall be contacted prior to conducting emergency response training.

24. Training Records

a. General training and training for atmospheric monitoring personnel will be recorded by the subcontractor or provider. This record will include each employee's name, date of training, and signature of the trainer. The training records (copy) will be forwarded to Bettis as part of the "supplemental safety plan."

b. Training for emergency response personnel for PRCS entries will be recorded by the cognizant supervisor or Qualified Person designated by the supervisor. This record will include each team member's name, date of training, and signature of the trainer. The training records (copy) will be forwarded to Safety Engineering and Medical.

c. The training records shall be available for inspection by employees and their authorized representatives.

25. Program Assessment

a. Safety Engineering shall evaluate the overall requirements for confined space work at least every two years. A report of this evaluation shall be issued to the Manager of Radiological Controls and Engineering (RC&E).

U. RELEASE OF POLLUTANTS

The Seller shall strictly adhere to all air and water pollution, chemical waste disposal and spill prevention and control requirements of the Laboratory applicable to work under this contract, as identified by the cognizant Bettis representative. The Seller is prohibited from permitting any emission of pollutants without specific prior approval of the cognizant Bettis representative. In particular, the Seller is prohibited from discharging any substances into on-site sewers (sanitary or storm) without specific, prior approval of the cognizant Bettis representative. See the section on Environmental Control Requirements in the "Special Conditions" document for additional information and guidance.

V. CONTROL OF HAZARDOUS ENERGY (Lockouts and Tag-outs)

1. General

This section covers the general safety rules for the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment, or the release of stored energy could result in injury to employees. Training, inspection, and review requirements are also outlined. Refer to Appendices 5 and 6 of this manual for detailed Lockout and Tag-out procedures. These requirements are based on 29CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tag-out)." Definitions for the terms used in this section and Appendices 5 and 6 are found in Table V-1.

2. Application

a. This section applies to the control of energy during servicing and/or maintenance of machines and equipment such as:

(1) When an employee is required to remove or bypass a guard or other safety device.

(2) When an employee is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed upon material being processed (point of operation) or where an associated danger zone exists during a machine's operating cycle.

(3) When working on de-energized electrical circuits and equipment.

b. Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this section if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection from injury.

3. Major Exceptions

a. The following are not controlled by the rules of this section in accordance with 29 CFR 1910.147.

(1) Installations under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution, including related equipment for communication or metering.

(2) Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations.

(3) Work on cord or plug connected electric equipment for which exposure to the hazards of unexpected energization startup of the equipment is controlled by the unplugging of the equipment from the energy source and the plug is under the exclusive control of the person performing the servicing or maintenance.

(4) Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products when they are performed on pressurized pipelines, provided that the following requirements are demonstrated.

(a) Continuity of service is essential.
(b) Shutdown of the system is impractical.
(c) Documented procedures are followed.
(d) Special equipment is used which provides proven effective protection for employees.

4. Energy Control Program (Lockout/Tag-out)

The program consists of an energy control procedure and employee training to ensure that before any employee performs servicing or maintenance on a machine or equipment where the unexpected energizing, startup, or release of stored energy could occur and cause injury, the machine or equipment is isolated, and rendered inoperative.

a. This isolation shall be in accordance with the Lockout and Tag-out procedures outlined in Appendices 5 and 6.

b. For more complex systems, involving intricate or multi-phase lockout arrangements, where Appendix 5 cannot be followed verbatim or where lockouts are not feasible, Bettis management shall ensure specific written procedures are used. Safety Engineering shall be requested to review and approve these procedures on an individual case basis.

c. Protective materials such as chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided and use when needed for isolating, securing, or blocking machines or equipment from energy sources.

5. Lockout and Tag-out Devices

Lockout and tag-out devices shall be singularly identified. They shall be used for controlling energy and shall not be used for other purposes.

6. Inspection and Review

Periodic inspection and review of the energy control procedure (lockout/tag-out) shall be conducted by subcontractor supervisors during their routine safety inspections. This inspection can also be delegated to an authorized employee, provided he or she is not the one utilizing the energy control procedure being inspected.

a. As a minimum, each area utilizing the energy control procedure will conduct an annual inspection.

b. The inspection shall be used to correct any deviations or inadequacies observed.

c. The inspection shall include a review with each authorized employee, of that employee's responsibilities under the energy control procedure being inspected.

7. Training and Communication

The subcontractor shall provide training to ensure that the purpose and functions of the energy control program are understood. Ensure employees have the knowledge and skills required for the safe application and removal of energy controls.

a. Each authorized employee shall receive training in the recognition of hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary to control and isolate this energy.

b. Each affected Seller employee shall be instructed in the purpose and use of the energy control procedure.

c. All other Seller employees whose work operations are or may be in the area where energy control procedures are utilized, shall be instructed about the procedure, and the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out and tagged out.

8. Retraining

a. Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment, or processes that present a new hazard, or when there is a change in the energy control procedure.

b. Additional retraining shall also be conducted whenever a periodic inspection reveals, or whenever the subcontractor has reason to believe, that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

c. Retraining is also required as part of paragraph 6.c, which requires a review with each authorized employee during inspection of the energy control procedure.

d. Retraining shall re-establish employee proficiency and introduce new or revised control methods and procedures, as necessary.

e. The subcontractor shall certify that employee training has been accomplished and is being kept up-to-date. This certification shall contain each employee's name and dates of training.

9. Outside Personnel (Contractors)
Whenever outside servicing personnel are engaged in activities covered by this section, the Bettis area line supervisor and the outside service contractor shall inform each other of their respective energy control procedures. The Bettis area line supervisor shall allow the service subcontractor to use his (the vendor's) procedure so long as it is not in conflict with 29CFR 1910.147. Safety Engineering shall be required to review conflicts between Bettis management and subcontractors prior to the start of work.

a. The area or line supervisor shall ensure that his or her employees understand and comply with restrictions and prohibitions of the subcontractor's energy control procedure.

10. Terms Applicable to the Control of Hazardous Energy

See Table V-1 for definitions applicable to the control of hazardous energy found in this section and Appendices 5 and 6.

TABLE V-1

TERMS APPLICABLE TO THE CONTROL OF HAZARDOUS ENERGY

Affected Employee - An employee whose job requires him or her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout and tag-out.

Authorized Employee - A person who locks and implements a tag-out system procedure on machines or equipment to perform the servicing or maintenance on that machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing maintenance or service on a machine or equipment that must be locked and tagged.

Blank Flange - A solid plate or cap (also called a "line blind" or "pancake") installed in a pipe, line, or duct, to ensure its absolute closure and to prevent passage of any material.

"Capable of Being Locked Out" - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it.

Dissipate - To release residual energy from a machine or system so that all energy is reduced to a level tolerable to humans (see "Zero Energy State").

Energized - Connected to an energy source or containing residual or stored energy.

Energy - The force that is present in a machine or system because of movement or the possibility of movement.

Energy Isolating Device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch, a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a pushbutton, selector switch, and other control circuit type devices.

Energy Source - Any power supply for industrial systems, to include electrical, mechanical, chemical, hydraulic (pressurized liquid), pneumatic (pressurized gas or air), and thermal (heat or cold) energy, as well as gravity and radiation.

Engineering Lockout - Any mechanical or electrical safety interlock device designed and built into a machine or system to provide automatic protection against human error.

Hazardous Energy - Any type of energy that could cause injury or death because it exceeds the level of human tolerance.

TABLE V-1 (Cont'd)

Hot Top - A procedure used in the repair, maintenance, and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout - The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout Device - A device that utilizes a positive means such as a lock to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

Multiple Lock Hasp - A lock adapter (also called a "clip") that is placed directly on a point of control or on a lockout device to allow positive lockout by more than one worker.

Normal Production Operations - The utilization of a machine or equipment to perform its intended production function.

Point of Control - Any electrical or mechanical device, such as a switch or valve, that regulates or stops the flow of energy between a machine or system and its energy source(s).

Potential Energy - The force that is "stored" within an object even when it isn't moving, such as a spring under tension.

Residual Energy - Latent ("leftover") energy that remains in a machine or system after it has been shut down, such as a turning blade or shaft, electricity in a capacitor, or trapped pressure that could unexpectedly release hazardous material or operate a moving part during the work.

Servicing and/or Maintenance - Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning, or un-jamming of machines or equipment and making adjustments or tool changes; where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Tag-out - The placement of a tag-out device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tag-out device is removed.

Tag-out Device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tag-out device is removed.

Zero Energy State (ZES) - The state of a machine or system in which residual energy in any form has been dissipated to a safe level, and lockouts have been installed and verified.

W. ASBESTOS CONTROLS

All building materials used at Bettis shall be asbestos-free. The removal, encapsulation, renovation, or demolition of previously installed building materials that might contain asbestos requires that the cognizant Bettis representative obtain the approval of Radiological Controls and Engineering and that the Seller comply with the work controls listed below. If the asbestos content of suspect building materials is not known, the substance will be assumed to be asbestos and all work controls including a "supplemental safety plan" and indoctrination shall apply.

The abatement, renovation, demolition, and encapsulation of asbestos-containing building materials at Bettis are controlled through the issuance of an Asbestos Work Permit by Bettis Environmental Controls. This permit should be applied for well in advance of the proposed work. This is required so that all the asbestos requirements of the Allegheny County Health Department, Bureau of Air Pollution Control, Article XX, Chapter X, Section 1001 Asbestos Abatement; Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants; Asbestos 40CFR61, OSHA Asbestos Construction Standard 29CFR 1926.58; and the PA Department of Labor and Industry 1990 Act 194 Asbestos Occupations Accreditation and Certification Act and any subsequent regulations from this Act will be met.

X. TANK ROLLERS

Tank rollers, express rollers, and similar equipment are to be used only by personnel authorized, designated, and trained by the Seller.

1. When used, tank rollers must be captured and secured to the load to maintain control of both the load and rollers; floor surfaces shall be leveled to assure the rollers and loads remain in contact with each other. In certain special cases the use of unsecured rollers may be necessary and reasonable. In these cases, the user shall prepare a procedure addressing the salient features of the application and obtain Bettis approval before performing the operation.

Y. JACKHAMMERS/PAVEMENT BREAKERS

The following personal protective equipment shall be worn in conjunction with jackhammering or rotohammering operations:

1. Safety glasses.

2. Foot protection with metatarsal guards.

3. Ear plugs and/or muffs shall be worn while jackhammering or assisting the jackhammer operator.

4. Insulated protective gloves with leatherwork gloves covering the insulated gloves shall be worn when jackhammering concrete or other material where the location of underground electric powerlines is unknown or where the powerlines are identified in the proximity of the jackhammering operation. If there is any doubt as to the reliability of the drawings or if there is any visual evidence that conduit(s) entered the ground in the vicinity of the jackhammering operation, the insulated gloves shall be worn.

5. Insulated protective gloves with cover leatherwork gloves also shall be worn when working with bars or other hand tools.

6. The insulated protective gloves described in 4. and 5. above shall be, as a minimum, Class II-20,000 volts AC proof-tested linemen's gloves. They shall be visually inspected by the wearer prior to each day's work. The visual inspection shall include checking for snags or holes, age and sun cracking, and swelling caused by oils and petroleum compounds.

Z. INTERNAL COMBUSTION MOBILE EQUIPMENT

1. Equipment with internal combustion engines can cause high levels of carbon monoxide to be generated. It does not matter if the fuel is gasoline or propane, both produce carbon monoxide. As such, the use of internal combustion equipment such as forklifts and aerial lifts is prohibited within buildings except as noted below:

   a. The delivery or pickup of material with such mobile equipment is permitted through truck doors provided the doors remain open to provide ventilation. The pickup or delivery should be performed as expeditiously as possible, minimizing the time the equipment is operating within the building. If there are exhaust fans in the immediate area, these fans are to be operating to help ventilate the area. If a delay occurs, the equipment shall be turned off or moved outside to prevent carbon monoxide from accumulating within the building.

   b. Protection Systems must approve the parking of internal combustion mobile equipment inside any building at Bettis. Propane-powered equipment will also have the propane valve on the cylinder turned off.

   c. Mobile equipment may be used indoors for extended periods of time (greater than five minutes total time) if its exhaust is vented directly to the outside using a hose or hose and fan combination, as appropriate. Ensure the exhaust outlet is not near ventilation intakes.

   d. If the exhaust cannot be readily vented outside in this manner, contact the cognizant Bettis representative to determine if monitoring for carbon monoxide is required. If monitoring is approved, the time-weighted average (TWA) must be less than 25 PPM (see NOTE).

      (1) Priority consideration should be given to using electrically operated mobile equipment inside of buildings.

      NOTE: TWA - The time weighted average concentration for a normal eight-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly exposed without adverse effect. PPM - Parts of vapor or gas per million parts of contaminated air by volume at 25˚C and 760 torr.

AA. COMPRESSED AIR

1. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi, and then only with effective chip guarding and personal protective equipment.

2. Compressed air shall never be used to clean the clothing or skin of personnel. It shall never be directed at a person's face or body.

BB. LEAD CONTROLS

1. Operations requiring lead controls include:

   a. handling bare lead;

   b. removal of lead bearing paints;

   c. welding, cutting, brazing, or grinding with lead alloys or on lead-painted surfaces; and

   d. construction, renovation, or demolition activities unless walls and other surfaces are verified lead-free.

2. A written "supplemental" Lead Control Plan shall be prepared and approved by Safety Engineering.

3. Airborne monitoring shall be provided for representative numbers of personnel who may be exposed above the OSHA Action Level for airborne lead.

4. Employees exposed or anticipated to be exposed to lead shall be trained before exposure and at least annually thereafter.

5. Respiratory protection shall be required for work with potential of lead exposure until:

   a. materials are verified lead-free, or

   b. previous monitoring under the same conditions verifies airborne lead levels below the Permissible Exposure Limit (PEL).

6. Protective equipment, including gloves, outer clothing, and respiratory protection shall be provided as required.

7. Choice of respiratory protection shall be governed by results of airborne monitoring or, if previous monitoring under the same conditions is not available, in accordance with assumed OSHA exposure guidelines.

8. Work involving potential exposure to lead shall include engineering controls such as removal of lead-bearing paint and use of HEPA-filtered ventilation.

9. Workers shall employ appropriate hygiene practices, including prohibition on eating in lead work areas and provision for washing hands and face.

10. Cleaning shall be accomplished with wet wiping and/or HEPA-filtered vacuums. No sweeping or blowing shall be performed.

11. Additional information and requirements are available in 29 CFR 1926.62.